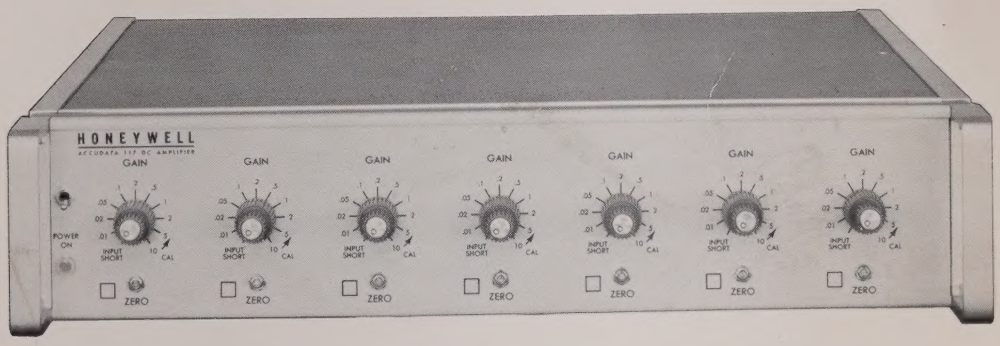
Technical Manual

INSTRUCTIONS FOR

ACCUDATA 117
MULTI CHANNEL DC AMPLIFIER



Honeywell

TEST INSTRUMENTS DIVISION
P.O. BOX 5227 • DENVER, COLORADO • 80217

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Technical Manual

INSTRUCTIONS FOR

ACCUDATA 117
MULTI CHANNEL DC AMPLIFIER

APRIL 1972

NOTICE

This Technical Manual is prepared in accordance with standards of good commercial practice. It is not intended in whole or in part to satisfy requirements of Military or Government specifications. Preparation of contents to such specifications will be quoted on request.

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SECTION I - DESCRIPTION

1-1 INTRODUCTION

Accudata 117 is a multi-channel instrument with up to seven direct coupled amplifiers in a single chassis. The amplifiers are solid state, wide-band, single-ended floating, and have low gains. This instrument is particularly useful in high speed data acquisition systems where the amplifiers are used to drive galvanometers and/or magnetic tape recorders. Six and four channel versions are also available.

1-2 FUNCTION

Accudata 117 amplifies DC and AC voltages, and provides proper impedance matching and isolation between the voltage source and subsequent equipment. Each channel has a multi-position gain switch and a vernier control that permits a wide range of inputs up to ±300 volts DC or peak AC. The maximum rated output is ±3.0 volts DC or peak AC at 40 milliamperes. Currents up to 65 milliamperes are permitted when the output voltage is held to 2.5 volts or less.

1-3 EQUIPMENT DESCRIPTION

Accudata 117 is a compact instrument, $3\frac{1}{2}$" high x 19" wide x $16\frac{1}{2}$" deep, that has been designed to mount in a standard 19" equipment rack. The amplification circuits are individually shielded and are mounted at the front of the chassis. All power supplies, one for each amplifier channel, are contained on a common circuit board that derives AC power from a single transformer with multiple secondary windings.

1-3-1 Front Panel Controls

POWER switch S3, in the upper left corner of the front panel, controls AC power for all amplifier channels. Power is on when S3 is set to its up position and this condition is indicated by a white lamp. The following controls are provided for each amplifier (see Figure 1-1):

a. GAIN switch S1 has fixed gain steps of .01, .02, .05, .1, .2, .5, 1, 2, 5, and 10. The INPUT SHORT position shorts the amplifier's high input to signal common.

b. GAIN potentiometer R23 is combined with CAL switch S2 on a shaft that is concentric with S1. When this control is fully counterclockwise in its detent position, S2 is closed to shunt R23 and the amplifier gain is fixed by S1. When this control is moved clockwise from its detent position, S2 is open and R23 increases the gain selected at S1; fully clockwise increases the gain by a factor of 2.5. Example: When S1 is set to 5 and R23 is fully clockwise, the gain is 12.5.

NOTE

Instruments may be obtained with S1 and R23 scaled in volts per inch sensitivities, see paragraph 1-4.

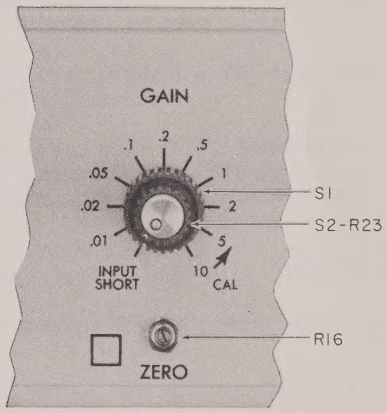


Figure 1-1 Amplifier Front Panel

c. ZERO potentiometer R16 is a screwdriver adjustment that is used to obtain a zero output when S1 is set to INPUT SHORT and S2 is fully counterclockwise to its detent position.

1-3-2 Rear Panel Features

a. Separate three-pin input connectors, J1 through J7, are provided for each amplifier channel.

b. Output signals for all amplifier channels are taken at J8, a fourteen-pin OUTPUT connector.

c. Power-source switch S4 permits the selection of two different sources of AC power. When set to 115, a 105 to 129 volts AC power source must be used. When set to 230, a 210 to 258 volts AC power source must be used. Either source must be single phase from 48 to 440 Hz.

d. Power fuse F1 is selected according to the power source. When S4 is set to 115, a 3/4 ampere, slo-blo fuse must be used, and when S4 is set to 230, a 3/8 ampere, slo-blo fuse must be used. There are no internal fuses.

e. AC power is applied through J9, a three-prong power connector. The power cable is supplied

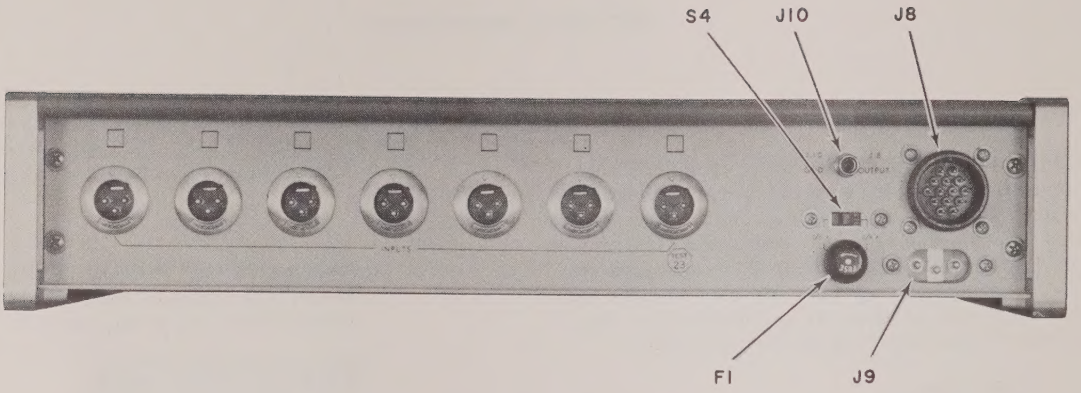


Figure 1-2 Accudata 117 Rear Panel

with the instrument.

f. Shielding for the output cable terminates at CHASSIS connector J10.

1-4 OPTIONS

There are six standard options in the Accudata 117 series:

a. Models 117-04, 117-06, and 117-07 have four, six, and seven channels, respectively, that are scaled according to gain. The front panel switches for these options are labeled as shown in Figure 1-1 and explained in paragraph 1-3-1.

b. Models 117-14, 117-16, and 117-17 have four, six, and seven channels, respectively, that are scaled according to volts per inch sensitivity. On these models, front panel switch S1 is labeled SENSITIVITY and it provides fixed sensitivity steps of 100, 50, 20, 10, 5, 2, 1, .5, .2, and .1 volts per inch and an INPUT SHORT position. Potentiometer R23 increases the sensitivity selected at S1 up to a factor of 2.5 as it is moved clockwise. Example: When S1 is set to 100 and R23 is fully clockwise, the amplifier sensitivity is 40 volts per inch. Table 1-1 shows the relationships between the GAIN and SENSITIVITY scales and the maximum variations introduced by R23 for each operational position of S1.

Gain Steps Selected at S1	Maximum Gain Obtained By R23	Sensitivity Steps Selected at S1	Maximum Sensitivity Obtained by R23
.01	.025	100 V/in	40 V/in
.02	.05	50 V/in	20 V/in
.05	.125	20 V/in	8 V/in
.1	.25	10 V/in	4 V/in
.2	.5	5 V/in	2 V/in
.5	1.25	2 V/in	.8 V/in
1	2.5	1 V/in	.4 V/in
2	5	.5 V/in	.2 V/in
5	12.5	.2 V/in	.08 V/in
10	25	.1 V/in	.04 V/in

Table 1-1 Gain and Sensitivity Comparisons

1-5 SPECIFICATIONS

Input Circuit: Single-ended floating with overload protection.

Input Impedance: 1 megohm ±3%, shunted by less than 50 picofarads.

Signal Source Impedance: 10 kilohms maximum, unless otherwise noted.

Maximum Input Voltage:

a. Protected input: Up to ±300 volts DC or peak AC at all gain or sensitivity settings

b. Operational input: ±300 volts DC or peak AC at minimum gain or sensitivity setting and 3.0 volts output. Maximum input for rated output is reduced proportionally for higher gains or increased sensitivities.

Common Mode Rejection: Applies with up to 1 kilohm source impedance in high side of input.

a. DC: Greater than 130 db for all gain or sensitivity settings.

b. 60 Hz: Greater than 100 db for gains 10 to 25 or sensitivities 0.1 to 0.04 volt per inch. Greater than 70 db for all other gains or sensitivities.

c. 120 Hz: Greater than 90 db for gains 10 to 25 or sensitivities 0.1 to 0.04 volt per inch. Greater than 60 db for all other gains or sensitivities.

d. 400 Hz: Greater than 80 db for gains 10 to 25 or sensitivities 0.1 to 0.04 volt per inch. Greater than 50 db for all other gains or sensitivities.

Common Mode Voltage: Common mode rejection applies for all voltages up to maximum which is ±500 volts DC or peak AC.

Accuracy at DC: ±2% with vernier R23 in CAL position (fully counterclockwise).

Gain or Sensitivity Linearity: ±0.2% of full scale output at DC, exclusive of zero offset.

Gains: (See paragraph 1-4) Fixed steps of .01, .02, .05, .1, .2, .5, 1, 5, and 10. Vernier provides increases of all steps up to factor of 2.5 (multiplier), thus, maximum gain is 25.

Sensitivities: (See paragraph 1-4) Fixed steps of 100, 50, 20, 10, 5, 2, 1, .5, .2, and .1 volts per inch. A resistive matching network is required between amplifier output and galvanometer to obtain this calibration (see 2-5-2). The vernier provides an increase in sensitivity above the calibrated steps, up to a maximum of 2.5 (division); thus, maximum sensitivity is 0.04 volts per inch.

Frequency Response: Amplitude response is flat within ±5% from DC to 20 KHz.

Overload Recovery Time: Less than 100 microseconds to within ±1% of final value with overload 10 times full scale input up to maximum of 300 volts.

Crosstalk: Less than 0.2% of full scale output from DC to 2 KHz at any gain or sensitivity setting.

Output Circuit: Single-ended with power supply common to low terminal.

Output Impedance: 0.5 ohm at DC, maximum; 2.0 ohms at 20 KHz, maximum.

Output Voltage and Current: ±3.0 volts DC or peak AC and/or 40 ma from DC to 20 KHz with capacitive loads up to 0.1 microfarad.

±2.5 volts DC or peak AC and/or 65 ma from DC to 20 KHz with capacitive loads up to 0.1 microfarad.

Capacitive Loading: 0.1 microfarad maximum.

DC Stability: Less than 150μV/°C drift for gains 10 to 25 or sensitivities 0.1 to 0.04 volt per inch; typically less than 100 μV/°C.

Less than 3 mv/°C for all other gains or sensitivities.

Line Regulation: Less than ±2 millivolts output change for any fixed gain or sensitivity setting with ±10% line voltage change.

Noise Level: Less than 2 millivolts rms over DC to 20 KHz band for all gains or sensitivities with 10 kilohm source impedance and input shield connected to low terminal at source.

Environmental:

Temperature: 0° to 50°C operating, -55°C to 60°C storage.

Humidity: Up to 95% relative humidity, operation or storage.

Altitude: Up to 10,000 feet operation, up to 50,000 feet storage.

Vibration: MIL-T-4807A.

Power Requirements: 105 to 129 volts AC, 50 watts or 210 to 258 volts AC, 50 watts, 48 to 440 Hz (115-230 select switch on rear panel).

SECTION II — OPERATION

2-1 INSPECTION

After unpacking, inspect the equipment. If shipping damage is found, report the facts to the shipping agency and to Honeywell. If equipment fails to operate as specified, check all connectors, cables, and fuse. Should equipment fail to operate satisfactorily during the warranty period, follow the procedure outlined in the warranty.

2-2 MOUNTING

The instrument is designed to mount in a standard 19" equipment rack and it requires $3\frac{1}{2}$ inches of vertical rack space. Attach the instrument to a standard equipment rack using four 10-32 $\frac{1}{2}$ inch screws with lock washers and nuts. Refer to Figure 2-1 for mounting clearance and dimensions.

2-3 PRECAUTIONS

a. The common mode voltage should not exceed ±500 volts DC or peak AC.

b. The input voltage should not exceed ±300 volts DC or peak AC.

c. With the maximum rated common mode voltage and the maximum rated input voltage it is possible to have as much as 800 volts potential on the input connector; this condition should be avoided.

2-4 INPUT, OUTPUT, AND POWER CONNECTIONS (See Figures 6-8 and 6-9)

a. Inputs to amplifier channels 1 through 7 are received at rear panel connectors J1 through J7, respectively. Pin connections are identified in Table 2-1. Mating connectors are Cannon XLR-3-11C plugs (Honeywell part No. 16761253-002).

b. All amplifier outputs terminate at J8, a 14-pin rear panel connector. Pin connections are identified in Table 2-1. A two-part, plug and collar, mating connector is used. The plug is a Cannon type AN 3106A-20-27S (Honeywell part No. 16100171-001) and the collar is a Cannon type AN 3057-12 (Honeywell part No. 16750300-006). Shielding for the output cable is terminated at CHASSIS connector J10.

c. Before the AC power cable is connected to the AC line, ensure that the power selector switch S4 is in the correct position. Set S4 to 115 if a 105-125 volt AC power source is used or set S4 to 230 if a 210-250 volt AC power source is used. Check the value of power fuse F1, it should be 3/4 amp slo-blo for 115 volts AC and 3/8 amp slo-blo for 230 volts AC.

J1 THRU J7	CONNECTS TO	J8	CONNECTS TO
3	Signal Input	A	Channel 1 Output
2	Signal Common	B	Channel 1 Common
1	Chassis Ground	C	Channel 2 Output
		D	Channel 2 Common
		E	Channel 3 Output
		F	Channel 3 Common
		G	Channel 4 Output
		H	Channel 4 Common
		I	Channel 5 Output
		J	Channel 5 Common
		K	Channel 6 Output
		L	Channel 6 Common
		M	Channel 7 Output
		N	Channel 7 Common

Table 2-1 Input and Output Pin Connections

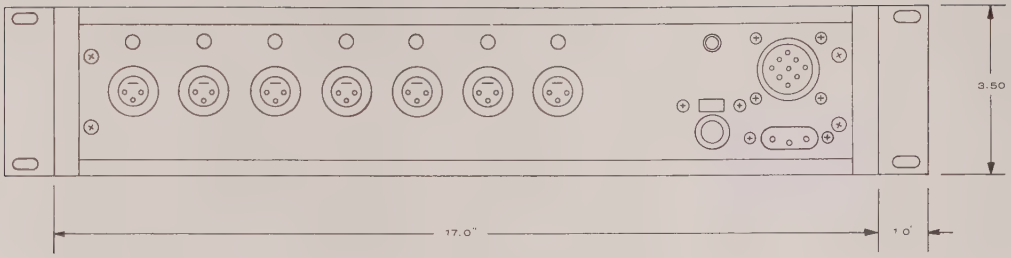
2-4-1 Input Cables

Several types of input cables may be used. The most common is a two-wire shielded cable with the low wire connected to the shield at the source as shown in Figure 2-2; this is a floating input connection and it is used where common mode voltages are encountered. When the floating operation is not desired, a non-floating input is obtained by connecting the shield to pin 1. A coaxial cable may also be used for the non-floating input connection. In this case, pins 1 and 2 are joined to the shield.

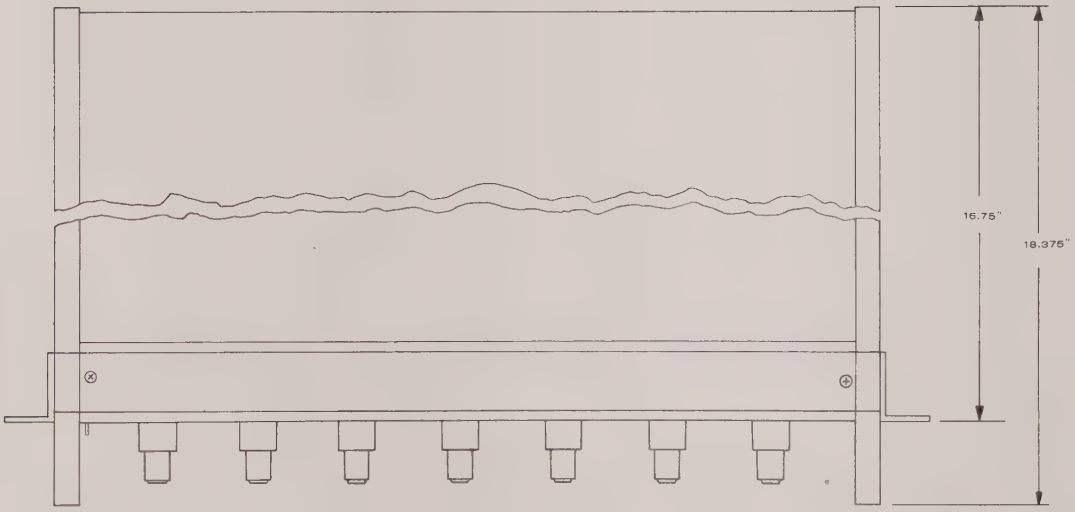
To realize the high common mode rejection of the Accudata 117, it is essential that the external wiring be properly installed. Stray capacitance will cause a significant loss in rejection at 60 Hz or higher frequencies, therefore, it is important that all connections to the input are properly shielded.

Due to the high input impedance and wide band characteristics of the amplifier, a double-shielded single conductor should be used when the signal low side is above ground by more than 1 kilohm. In this case, the inner shield connects between the source low side and pin 2, and the outer shield connects between source ground and pin 1.

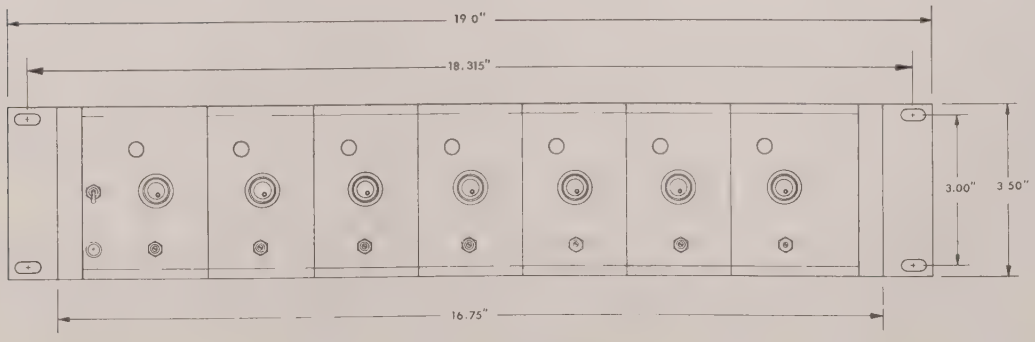
When long input lines are used, and it is necessary to ground the source and the amplifier chassis to different points, there should be a low resistance conductor between these points to minimize the potential difference. The double-shielded single conductor may also be used in this case with the outer shield providing the low resistance path between grounds.



a. Rear View



b. Top View



.c. Front View

Figure 2-1 Dimensional Diagram

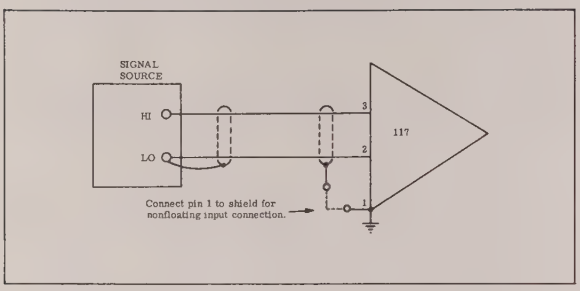


Figure 2-2 Typical Floating Input Connection

2-4-2 Output Cable

A single 14-wire output cable is satisfactory in most amplifier applications. This cable can be shielded to prevent any small stray pickup and the shield can be terminated at rear panel connector J10. (The low output impedance of the amplifier, less than 2 ohms, makes stray pickup unlikely.)

Coaxial output cables should be avoided where possible. The high shield-to-center conductor capacitance of coaxial cable can cause problems in termination and results in ringing. This ringing results as the capacitive load exceeds 0.1 microfarad and this load point is easily exceeded with coaxial cabling.

2-5 GALVANOMETER MATCHING

2-5-1 Electromagnetically Damped Galvanometers

Each Honeywell M-series electromagnetically damped galvanometer must be matched to its critical damping resistance R_d to obtain the best compromise between overshoot and frequency response. Proper damping reduces overshoot to a minimum, while providing the best flat frequency response. Matching the Accudata 117 output to these galvanometers requires the addition of series and shunt resistors between the output and galvanometer as shown in Figure 2-3.

The values of R_{se} and R_{sh} required to obtain a specific galvanometer deflection from a known amplifier output voltage can be calculated from the following equations:

$$R_{se} = \frac{R_d E_o}{I_g (R_d + R_g)}$$

$$R_{sh} = \frac{R_{se} R_d}{R_{se} - R_d}$$

Where E_o = Amplifier output voltage

R_g = Galvanometer coil resistance

R_d = Critical damping resistance

I_g = Galvanometer current for the required deflection

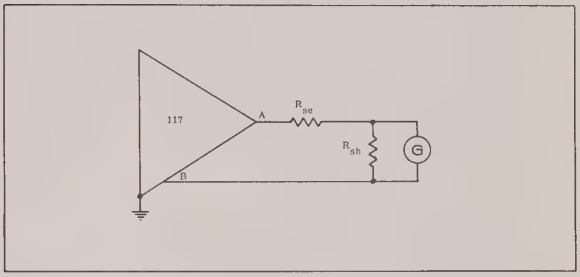


Figure 2-3 Galvanometer Connection

The closest MIL values of R_{se} and R_{sh} which provide full rated deflection of each galvanometer type for full scale amplifier output (2.5 volts) are listed in Table 2-2.

Honeywell Galvanometer	R_d Ohms	R_{se} (Ohms)	R_{sh} (Ohms)
M24-350	350	301K	357
M40-120A	120	63.4K	121
M40-350A	350	130K	357
M100-120A	120	44.2K	121
M100-350	350	82.5K	357
M200-120	120	16.5K	121
M200-350	350	21K	357
M400-120	120	4.32K	124
M400-350	350	6.04K	374
M600-350	350	1.87K	432

Table 2-2 Damping Resistors For 8" P-P Deflection

2-5-2 Fluid Damped Galvanometers

The Accudata 117 output can drive Honeywell M-series fluid-damped galvanometers directly or through a series-and-shunt resistor network. The direct connection provides maximum galvanometer sensitivity, but has two disadvantages:

1) Galvanometer voltage sensitivity is determined entirely by coil resistance and current sensitivity (ma/inch).

2) Lower frequency fluid-damped galvanometers (M1000 and M1650) have such a high sensitivity

that the amplifier operates at only a fraction of full-scale output. This results in a reduced signal-to-noise ratio. Insertion of series and shunt resistors between the amplifier and galvanometer overcomes both of these disadvantages. Choice of these resistors can provide maximum allowable galvanometer deflection for an amplifier output near full scale, and maximum signal-to-noise ratio.

Proper galvanometer calibration provides the desired sensitivity referred to the amplifier output (e.g., 1 volt per inch). The galvanometer sensitivity, referred to the amplifier input, is obtained by dividing output sensitivity by the amplifier GAIN setting.

Whether the galvanometer is driven directly or through a resistor network, protection of the galvanometer is one of the first considerations in the event that the amplifier output is driven beyond the voltage required for maximum allowable galvanometer deflection.

Table 2-3 lists coil current limits; observe them to prevent permanent damage to the galvanometer.

Maximum amplifier output current is approximately ±80 ma when driving a galvanometer, but the maximum current varies as a function of load impedance, amplifier tolerances, temperature, and age. A worst case variation in maximum output current from 75 to 95 ma can occur. The maximum safe current through Honeywell fluid-damped galvanometers ranges from 50 to 80 ma dc or peak ac. Since the maximum galvanometer currents are all less than 95 ma, some means of shunting the excess amplifier current must be provided. A resistor shunted across the galvanometer is the recommended means of shunting the excess current. A shunt resistance value for each galvanometer type is given in Table 2-3, chosen to limit the galvanometer current to the specified maximum when the amplifier current is maximum (95 ma). If the amplifier limit is at the minimum value (75 ma), the galvanometer current is limited to a proportionately lower value. With the shunt resistor installed, the galvanometer can be driven to the deflection shown in Table 2-3. Galvanometer voltage sensitivity is not affected by the addition of the shunt resistor.

When a specific galvanometer voltage sensitivity is desired, series resistance must be added between the amplifier output and the galvanometer. In general the galvanometer should still be shunted by its protection resistor, R_{sh}, to assure positive protection. An exception can be made when calibrating M1000 or M1650 galvanometers to sensitivities where the series resistance is sufficiently large to limit the amplifier output current. For example, calibrating the M1000 or M1650 to the standard Accudata 117 SENSITIVITY settings requires only a series resistor. The M3300 galvanometer can also be calibrated to the standard SENSITIVITY settings, but requires both a series and shunt resistor. The remaining fluid-damped galvanometers cannot be calibrated to the standard sensitivities because their voltage sensitivities exceed the 1.0 volt per inch at the amplifier output.

The resistors required to calibrate the M1000, M1650 and M3300 galvanometers to the standard SENSITIVITY settings are as follows:

Galvanometer	Rsh (ohms)	Rse (ohms)	Full Scale Deflection (inches)
M1000	∞	340	±3
M1650	∞	80.6	±3
M3300	169	15	±2

Note that the ±3 inch deflection limitation of the M1000 and M1650 is due to the ±3 volt full-scale output of the amplifier. Trimpot R22, which is

Galvanometer	Maximum Continuous Overload Current (mA)	Shunt Protection Resistor R_{sh} (ohm)	Maximum Galvanometer Deflection DC or Peak AC (inch)	Galvanometer Sensitivity (V/in.)
M1000	80	210	±4	0.103
M1650	80	143	±4	0.249
M3300	80	169	±2	0.640
M5000	80	210	±1.2	1.23
M8000	56	51.1	±0.8	1.40
M10000	56	51.1	±0.8	1.40
M13000	50	80.6	±0.4	5.84
M25000	60	84.5	±0.3	6.12

Table 2-3. Shunt Protection Resistors for Honeywell Galvanometers

accessible through the bottom cover, adjusts amplifier gain to calibrate the galvanometer. This adjustment compensates for the possible ±10% variation in galvanometer voltage sensitivity.

The value of R_{se} and R_{sh} required to obtain special amplifier/galvanometer sensitivities can be calculated from the following equation:

$$R_{se} = \left[\frac{R_g R_{sh}}{R_g + R_{sh}} \left(\frac{V_o}{V_g} \right) \right] - 1$$

where,

R_g = galvanometer coil resistance

R_{sh} = galvanometer shunt protection resistor from Table 2-3

V_g = galvanometer voltage sensitivity from Table 2-3

V_o = desired sensitivity at amplifier output in V/in.

The value of V_o is determined from the desired input sensitivity range and the calibrated gain settings of the amplifier. The calibrated gain steps have a 1000:1 range (0.01 to 10), and the range is extended at the high gain end by the vernier.

For example:

If it is desired to drive an M8000 galvanometer with an input sensitivity of 100mV/in. when the amplifier GAIN is 10, V_o = 100 x 10 = 1 volt/in. The voltage sensitivity of an M8000 galvanometer is 1.4 volts/in.; therefore, this calibration is not possible. If the input sensitivity is changed to 200mV/in., V_o = 200 x 10 = 2 volts/in., which is possible.

The calibrated input sensitivity steps for this example are .2, .4, 1, 2, 4, 10, 20, 100, and 200 volts/inch, and the series resistance is,

$$R_{se} = \left[\frac{35 \times 51.1}{35 + 51.1} \left(\frac{2}{1.4} - 1 \right) \right] = 9 \text{ ohms}$$

2-6 TAPE RECORDER CONNECTIONS

Most tape recorders have single-ended inputs with their low inputs grounded. Connect the high outputs of the amplifier channels (pins A, C, etc. of J8) to the high inputs of the recorder channels and the low outputs of the amplifier channels (pins B, D, etc. of J8) to the low inputs of the recorder channels. No special network is required between the amplifier and the recorder; Accudata 117 with its high input impedance and low output impedance provides a buffer between the recorder and its source.

2-7 OPERATING PROCEDURE

Use the following procedure when operating the Accudata 117:

a. Set the amplifier GAIN switch S1 to INPUT SHORT and rotate GAIN control R23 fully counterclockwise to its detent position.

b. Short the input of the recording device (load) and zero as required. For example, if recording with an oscillograph, mechanically position the galvanometer light spot to the desired zero position on the record. After the recording device has been zeroed, remove the short.

c. Apply AC power to the Accudata 117 and allow the amplifier to warm up.

d. Use a small screwdriver to adjust ZERO control R16 until the recording device returns to its initial zero position.

e. Set GAIN switch to the desired fixed gain position.

f. At the signal source, establish a zero signal for the amplifier input. Readjust ZERO control R16 for a zero reading at the load.

g. From the signal source, apply an input signal until the desired recording amplitude is observed at the load. If the fixed gain position of S1 does not allow the desired recording amplitude to be reached, rotate GAIN control R23 until the desired gain, between fixed steps, is reached. The amplifier is now ready for operation.

2-8 REPACKING FOR SHIPMENT

If the original shipping carton is not available, repackage the instrument as follows:

a. Wrap the instrument in heavy paper or plastic before placing in an inner container.

b. Place the unit in a heavy corrugated cardboard inner carton having approximately the same inside dimensions as the outside instrument dimensions.

c. Pack dunnage on all sides of the instrument, filling and tightly packing all open areas of the inner carton. Protect the front panel with cardboard strips.

d. Seal the inner carton and place it in a heavy corrugated outer carton. The outer carton should be large enough to allow a minimum of two inches of dunnage on all sides of the inner package.

e. Tightly pack dunnage between the inner and outer cartons, making certain no voids remain.

f. Seal the container with strong tape or metal bands. Mark the package "DELICATE INSTRUMENT, FRAGILE".

NOTE

If the instrument is to be shipped to Honeywell for service or repair, attach a tag to the instrument identifying the owner and indicate the service or repair to be done. Include the model number and full serial number of the instrument. In any correspondence, always identify the instrument by model number and serial number.

SECTION III — THEORY OF OPERATION

3-1 INTRODUCTION

Amplifiers in the Accudata 117 unit are solid state, single-ended floating, wide-band, and have low gains. Each consists of an input attenuator, input limiter, feedback network, and three principal stages – input buffer, voltage amplifier, and power output. These circuits, illustrated in block form by Figure 3-1, are shielded and mounted at the front of the chassis. A common circuit board provides individual power supplies for each amplifier.

3-2 CIRCUIT DESCRIPTION

This discussion is limited to models that have been scaled according to gain. Refer to paragraph 1-4 and Table 1-1 for a comparison of the gain and sensitivity scales.

3-2-1 Input Attenuator

The input attenuator consists of eleven precision resistors, three capacitors, and GAIN switch S1. The resistors, R1 through R11, form a voltage divider which is tapped by S1 to provide gain steps of 10, 5, 2, 1, 0.5, 0.2, 0.1, 0.05, 0.02, and 0.01. A constant input resistance of 1 megohm is maintained at all gain positions. Trim capacitors C1 and C2 neutralize the effects of attenuator capacitance on gain positions 5 and 2, and capacitor C10 reduces peaking at high frequencies on the lowest gain positions.

S1 has an INPUT SHORT position that connects the input buffer stage to signal common. The short position, used in conjunction with the ZERO screwdriver adjustment, provides a convenient method of establishing a zero output for a zero input.

3-2-2 Input Limiter and Input Buffer

The input limiter is a clamping network consisting of R12, R13, R14, CR1, and CR2. This network limits inputs to the input buffer to approximately ±2.0 volts.

The input buffer stage employs Q1, a dual field-effect transistor, in a differential source follower arrangement that presents a high input impedance to the output of the attenuator and a low output impedance to the input of the voltage amplifier stage. Resistors R15, R17, and ZERO potentiometer R16 form the source circuit of Q1. The ZERO potentiometer compensates for any mismatch of Q1-A and Q1-B and for offset bias in the voltage amplifier stage. Input signals are applied to the gate of Q1-A and the gate of Q1-B is used as a summing junction for the feedback which controls the closed loop gain of the amplifier. The output of the buffer stage is applied differentially to the input of the voltage amplifier stage.

3-2-3 Feedback Network

The feedback network is formed by R21 through R25, C7, and C8. R22 serves as an internal adjustment to set the nominal gain. R23 is the front panel vernier control that allows a gain adjustment of 1 to 2.5 times the gain selected by S1. When R23 is fully counterclockwise to its detent position, S2 is closed to shunt R23 and C8, and the amplifier gain is fixed by S1.

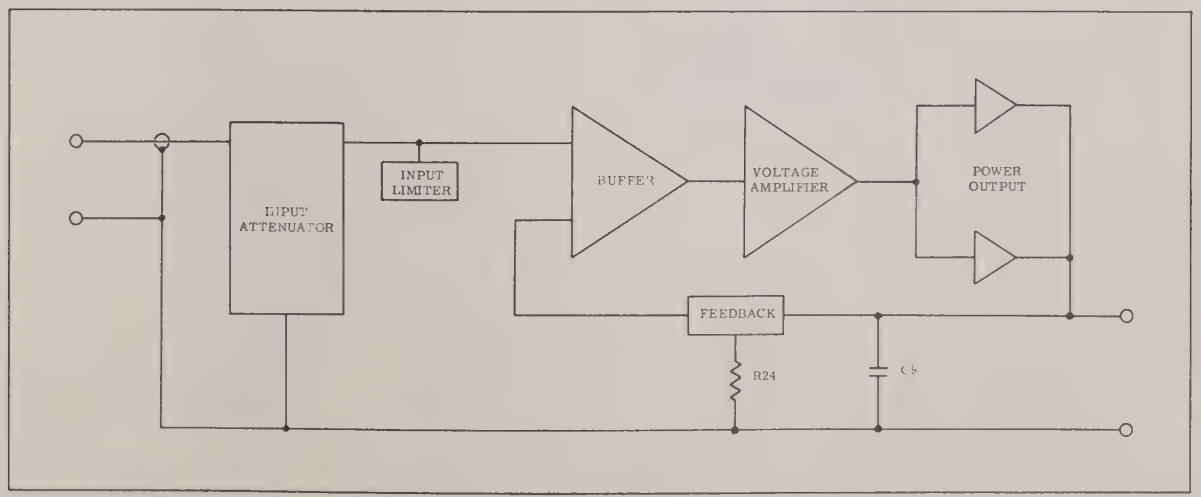


Figure 3-1 Amplifier Block Diagram

3-2-4 Voltage Amplifier

An integrated circuit, IC-1, is used as the voltage amplifier stage. This general purpose amplifier provides sufficient open loop gain to achieve required gain stability and linearity, and allows the closed loop gain to be essentially determined by the feedback network. The gain-phase characteristics of IC-1 are shaped by external compensation network R19-C4 and C5. Power supply decoupling for the voltage amplifier and input buffer stages is obtained by use of networks R18-C3 and R20-C6.

3-2-5 Power Output

Transistors Q1, Q2, and Q3 together with resistors R26 through R31 and diodes CR3, CR4, and CR5 form the power output stage. The output of the voltage amplifier is applied to the base of emitter follower Q2 to provide the current gain to drive the final output stage formed by complementary emitter follower Q3 and Q4. Q2 has a low output impedance and its high current output is applied to the final stage through diode string CR3, CR4, and CR5. Bias of Q2 is supplied through R26 and CR3. The no-signal current through Q3 and Q4 is determined by the voltage across the diode string, the base emitter voltage of Q3 and Q4, and resistors R29 and R30. Resistors R28 and R31 limit power dissipation in Q3 and Q4, and with resistors R29 and R30 limit the maximum output current of the amplifier. The output is applied to the feedback network to control the closed loop gain. Capacitor C9 provides a minimum capacitive load on the amplifier, thereby, reducing the range of capacitive loads over which the amplifier must be stable.

3-2-6 Power Supply

The power supply section provides regulated +15 volts and -15 volts to each amplifier channel from either a 115 volt or a 230 volt AC line. The line voltage is applied to the primary of T1 through power-source switch S4. The primary of T1 consists of two identical windings which may be connected in parallel or series through S4. In the parallel configuration, the supply operates from a 115 volt AC line and in the series configuration, the supply operates from a 230 volt AC line. Power transformer T1 has seven center-tapped secondary windings, one for each amplifier channel. The following circuit description pertains to each of the seven power supplies.

The center-tapped secondary voltage of T1 is applied to a full wave diode bridge, CR110. Positive and negative DC voltages from the bridge are filtered by capacitors C110 and C111, respectively. Each filtered voltage is applied to a separate regulator. Except for the polarity of transistors and Zener diodes, the regulator circuits are identical. Unregulated DC is applied to Zener CR111 and resistor R110 in the positive regulator and to Zener CR112 and resistor R112 in the negative regulator. Current through CR111 and CR112 is established by the voltage across R110 and R112, respectively. Reference voltages are determined by the Zener diodes and applied to the bases of Q110 and Q111 through R111 and R113. The reference voltages are further filtered by C112 and C113 which also reduce the output impedance of the supplies. The regulated outputs appear at the emitters of Q110 and Q111 and are applied to the various amplifier stages.

SECTION IV — CALIBRATION

4-1 GENERAL

Calibration of each amplifier consists of adjusting two trim capacitors in the input attenuator, a potentiometer in the feedback network, and the ZERO potentiometer on the front panel.

NOTE

GAIN settings are used in the calibration procedure. For comparable SENSITIVITY settings refer to Table 1-1.

4-2 REQUIRED CALIBRATION EQUIPMENT

a. Differential DC voltmeter with 1 millivolt sensitivity or better, Honeywell Model 1000 or equivalent.

b. Oscillator capable of supplying up to 160 milliwatts into 600 ohms over the frequency range 30 Hz to 20 KHz, Hewlett Packard Model 200 DC or equivalent.

c. AC voltmeter capable of measuring up to 300 volts RMS, accurate to ±1%, over the frequency range 30 Hz to 20 KHz, Hewlett Packard Model 400H or equivalent.

d. Oscilloscope with 1 millivolt sensitivity, Tektronix Model 502 or equivalent.

e. Precision DC power supply capable of supplying up to 300 volts DC, Hewlett Packard Model 721A or equivalent.

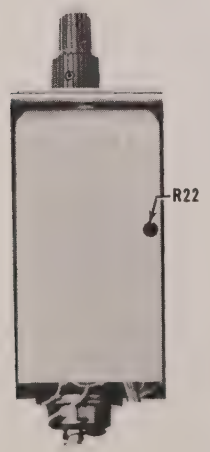


Figure 4-1 Bottom View of Typical Amplifier Channel

NOTE

This calibration equipment is also used for the amplifier checks in Section V.

4-3 CALIBRATION PROCEDURE

Calibration should be performed prior to the amplifier checks outlined in paragraph 5-3 and subsequent to any corrective maintenance. Remove the top and bottom panels from the instrument, each panel is held by two screws. Refer to Figure 4-1 to locate gain potentiometer R22 which is accessible through a hole in the metal guard shield, and refer to Figure 4-2 to locate trim capacitors C1 and C2 which are located under the metal guard shield. Set the POWER switch to its up position (power on), allow 15 minutes warmup, and proceed as follows:

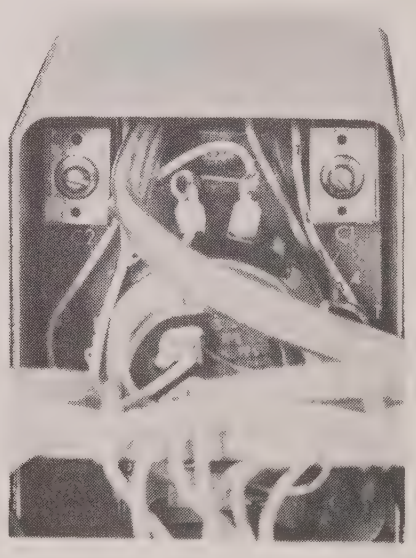


Figure 4-2 Rear View of Typical Amplifier Channel

4-3-1 Zero Output Adjustment

a. Connect the amplifier output to the DC voltmeter as shown in Figure 4-3.

NOTE

Figures 4-3, 4-4, and 4-5 show the output pin connections for amplifier channel one. Table 2-1 shows the output pin connections for all seven amplifier channels. The input pin numbers are identical for all channels.

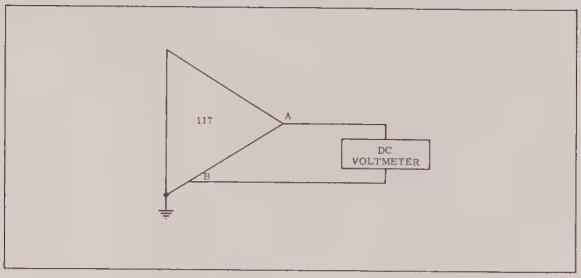


Figure 4-3 Zero Adjustment Test Setup

b. Set GAIN switch S1 to the INPUT SHORT position and rotate GAIN potentiometer R23 fully counterclockwise to CAL, its detent position.

c. Adjust ZERO control R16 for an output of 0 volt ±3 millivolts. The control is capable of adjusting the output voltage approximately ±0.25 volt from zero.

4-3-2 Nominal Gain Adjustment

a. Connect the amplifier as shown in Figure 4-4. The load resistance and capacitance can be any values within specifications, see paragraph 1-5.

NOTE

Use the output voltage and current specifications to determine the load resistance.

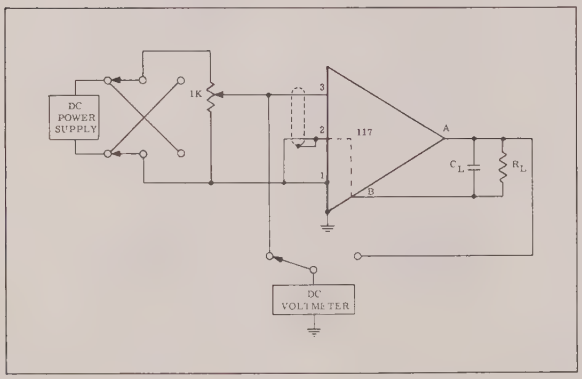


Figure 4-4 Gain Adjustment Test Setup

b. Set GAIN switch S1 to position 1 and rotate GAIN potentiometer R23 fully counterclockwise to CAL, its detent position. With the input shorted, verify that the output voltage is 0 volt ±3 millivolts. Note the output level.

c. With +2.5 ±0.002 volts DC on the input of the amplifier, adjust R22 (Figure 4-1) until the output is +2.5 ±0.002 volts DC. Reverse the polarity of the input voltage and verify that the output is -2.5 ±0.005 volts DC ±the value noted when the input was shorted.

NOTE

The above procedure uses a DC reference for setting the nominal gain, however if desired, a suitable AC source may be used. Set the input frequency at 100 Hz and use an AC voltmeter to monitor the output. This method has the advantage of eliminating the effect of any small DC output voltage that may be present on the amplifier output.

4-3-3 Frequency Response Adjustments

a. Connect the amplifier as shown in Figure 4-5. The load resistance and capacitance can be any values within specifications, see paragraph 1-5 and applicable NOTE in paragraph 4-3-2.

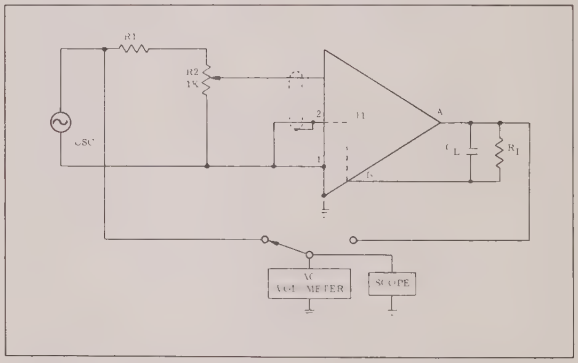


Figure 4-5 Frequency Response Test Setup (Gain $\geq$ 1)

b. Set GAIN switch S1 to position 5 and rotate GAIN potentiometer R23 fully counterclockwise to CAL, its detent position. R1 in the test setup should be a 3 kilohm resistor.

c. Adjust the oscillator for an output of 1.8 volts RMS at 100 Hz. Then adjust R2 in the test setup until the amplifier output is 1.8 volts RMS.

NOTE

The oscilloscope is used in the test setup to determine if there is distortion at the amplifier's output. If distortion is present, recheck the test setup to determine the cause and correct.

d. Increase the oscillator frequency to 20 KHz and maintain the oscillator output level at 1.8 volts RMS. (Do not readjust R2.) Adjust C1 (Figure 4-2) until the amplifier output level is 1.8 volts RMS. While maintaining the oscillator output level constant at 1.8 volts RMS, switch the oscillator frequency through the range from 20 KHz to 100 Hz or lower and verify the frequency response

of the amplifier to be within a ±0.5 db band about 100 Hz reference point.

e. Set the GAIN switch to position 2, leave R23 set to CAL, and change the value of R1 in the test setup to 600 ohms. Repeat the procedures in steps c. and d. to adjust C2 (Figure 4-2) for the proper frequency response at gain x2.

SECTION V — MAINTENANCE

5-1 PERIODIC MAINTENANCE

The Accudata 117 requires no periodic maintenance. The instrument can be operated continuously without adverse effect on its life.

5-2 DISASSEMBLY

The top and bottom panels are each held by two screws. After these panels are removed, the power supplies for all amplifier channels are in full view. Each amplifier is covered by a metal guard shield. The amplifier circuits and shields are held in place by the GAIN and ZERO controls. To gain access to an individual amplifier circuit, proceed as follows:

a. Turn the instrument over so the bottom side is facing up. Peel back the tape that overlaps the screws. Refer to Figure 6-1, page 6-5; Figure 6-3, page 6-9; and Figure 6-4, page 6-11 for disassembly.

b. Remove the metal brace that mounts adjacent to the front panel and above the amplifier guard shields. Do not remove the corresponding brace mounted under the amplifier guard shields.

c. At the amplifier channel in question, remove the hex nut that holds the ZERO adjustment in place.

d. Loosen Allen screws holding the two knobs on the GAIN control shafts. Slide knobs off.

e. Remove the hex nut securing the concentric GAIN control shafts to the front panel. Note the relative position of the metal star washer and insulating washer with respect to the front panel. Another insulating washer on the concentric shafts is positioned between the amplifier and the subpanel.

f. Use care to dislodge the amplifier and shield assembly from the front panel. Do not break any of the electrical connections to the power supply or to the input and output connectors.

g. The shield can be removed from around the amplifier and placed to one side.

h. Repairs can now be made to the amplifier, however, if these repairs are not as yet self-evident and power must be applied to the instrument, ensure that the amplifier circuits are properly insulated.

i. After repair, assemble the amplifier and its shield in the reverse order of disassembly.

j. Before the top and bottom panels are replaced, ensure that the metal guard shield is floating above chassis ground. Use an ohmmeter to make the following checks:

   (1) Determine that there is a direct short between pin 2 of the amplifier's input connector and the amplifier's metal guard shield.

   (2) Determine that there is an open between pins 1 and 2 of the amplifier's input connector.

   (3) Determine that all metal guard shields are isolated from each other and from the chassis.

5-3 AMPLIFIER PERFORMANCE CHECKS

Several checks may be used to determine that the amplifiers perform as specified. These checks should be performed after the amplifiers have been calibrated. In the event of a malfunction during the checks or calibration, make reference to paragraph 5-4. These checks will be an aid to trouble analysis. If component changes are made in an amplifier, recalibration is required.

5-3-1 Required Test Equipment

a. Equipment specified in paragraph 4-2.

b. True RMS voltmeter, Hewlett Packard Model 3400A or equivalent.

c. Voltage source capable of supplying up to 500 volts peak at 60 to 400 Hz, Holt Model 323 or equivalent.

d. Double shielded, 1:1 transformer with minimum primary inductance of 10 henries at 60 Hz and 1 volt, Triad G24 or equivalent.

5-3-2 Preliminary Steps

a. GAIN settings are used in the amplifier checks. For comparable SENSITIVITY settings, refer to Table 1-1.

b. Throughout the amplifier checks, leave the GAIN potentiometer R23 rotated fully counterclockwise to CAL, its detent position.

c. Connect the amplifier to the test circuitry recommended for each check. In each case, the load resistance and capacitance can be any values within the load specifications in paragraph 1-5. Use the output voltage and current specifications to determine the load resistance. The test circuits show the output pin connections for amplifier channel one. Table 2-1 shows the output pin connections for all seven amplifier channels. The input pin numbers are identical for all channels.

d. Set the POWER switch to its up position (power on) and allow 15 minutes warmup.

e. With the GAIN switch S1 set to INPUT SHORT, connect a differential voltmeter to the amplifier's output and adjust ZERO control R16 for an output of 0 ±3 millivolts.

5-3-3 Frequency Response

This procedure is applicable to gains of 1 or higher.

a. Connect the amplifier as shown in Figure 4-5. R2 should be a multiturn potentiometer, approximately 1000 ohms, to provide the required resolution. Select R1 (R1 = 0 for gain of 1) to provide the necessary attenuation at the desired gain setting of the amplifier.

b. Set GAIN switch S1 to position 10.

c. Adjust the oscillator to 1.8 volts RMS or less at 100 Hz.

d. Adjust R2 until the amplifier output voltage is precisely the same as the oscillator voltage. Switch the voltmeter between the oscillator and amplifier output several times, adjusting R2 until no difference exists between the voltage readings.

e. Observe the output voltage on the oscilloscope for distortion. If distortion is present, examine the test setup to determine the cause and correct it before proceeding.

f. With no further adjustment of R2, switch the oscillator frequency through settings of 500, 1000, 3000, 5000, 10,000, and 20,000 Hz. Adjust the oscillator amplitude to maintain the original voltage. Record the amplifier output voltage at each frequency. Calculate the deviation from a flat response at each frequency relative to 100 Hz.

NOTE

This procedure uses a response reference point of 100 Hz. If desired, use DC as the reference by replacing the oscillator with a DC power supply and adjusting R2 with a DC voltmeter instead of the AC voltmeter.

g. Repeat steps c. through f. with GAIN switch S1 set to positions 5, 2, and 1.

This procedure is applicable to gains less than 1.

h. Connect the amplifier as shown in Figure 5-1. R2 is a multiturn potentiometer, approximately 1000 ohms.

i. Set GAIN switch S1 to position .5.

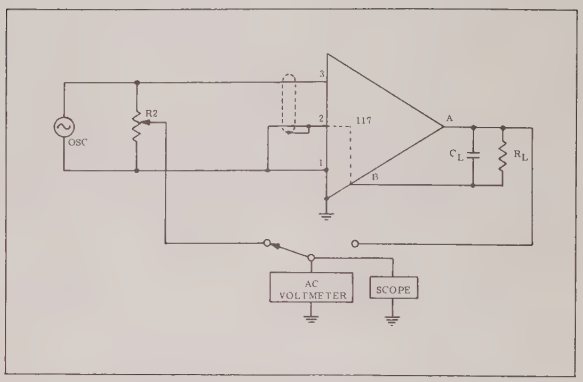


Figure 5-1 Frequency Response Test Setup (Gain < 1)

j. Adjust the oscillator until the amplifier output voltage is 1.8 volts RMS or less at 100 Hz.

k. Adjust R2 until the amplifier output voltage is precisely the same as the voltage on the arm of R2. Switch the voltmeter between the arm of R2 and the amplifier output several times, adjusting R2 until no difference exists between the voltage readings.

l. Observe the output voltage on the oscilloscope for distortion. If distortion is present, examine the test setup to determine the cause and correct it before proceeding.

m. With no further adjustment of R2, switch the oscillator frequency through settings of 500, 1000, 3000, 5000, 10,000, and 20,000 Hz. Adjust the oscillator amplitude to maintain the original voltage. Record the amplifier output voltage at each frequency. Calculate the deviation from a flat response at each frequency relative to 100 Hz.

n. Repeat steps j. through m. with GAIN switch S1 set to position .2. Use the same procedure with GAIN switch S1 set to position .1, .05, .02, and .01, but it will be necessary to observe the amplifier output at less than 1.8 volts RMS since the output of the oscillator is limited.

5-3-4 DC Gain Linearity

This procedure is applicable to gains of 1 or higher.

a. Connect the amplifier as shown in Figure 5-2. Use a well regulated DC power supply capable of supplying at least 2.5 volts. R1 and R2 should be 1000 ohm, multiturn potentiometers to provide adequate resolution. Select R3 to provide the necessary attenuation at the desired gain setting of the amplifier.

b. Set the GAIN switch S1 to position 10.

c. Set R1 and R2 so that no voltage is applied to the amplifier.

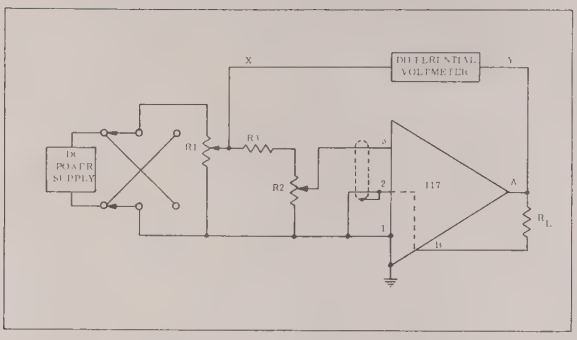


Figure 5-2 DC Gain Linearity Test Setup (Gain $\geq$ 1)

d. Adjust the amplifier ZERO control until the voltage indicated by the differential voltmeter is zero.

NOTE

Due to the resolution of the ZERO control, it will only be possible to zero the amplifier to within ±3 millivolts.

e. Adjust the voltage dials on the voltmeter until the voltmeter indicates a null.

f. Set the power supply to +2.5 volts and rotate R1 until the voltage at point X is also +2.5 volts.

g. Adjust R2 until the voltage between X and Y, as indicated on the differential voltmeter, returns to the null point established in step e.

h. Adjust R1 until the voltage at point X is again zero volts. If the reading differs from that established in step e, repeat steps e., f., and g., until the differential voltmeter indicates a null at each step when applying zero or +2.5 volts.

i. Vary the voltage at point X from +2.5 volts to zero, then to -2.5 volts. Note the maximum change on the differential voltmeter.

j. Using the figures obtained in step h., calculate the linearity (in % of full scale) of the output using the following equation: linearity (%) equals the maximum voltage difference between points X and Y multiplied by 100 and divided by the full scale output voltage (2.5 volts). For example, a voltage difference between points X and Y of 5 millivolts or less gives 0.2% linearity or better.

k. Repeat steps c. through j. with GAIN switch S1 set to positions 5, 2, and 1.

This procedure is applicable to gains less than 1.

1. Connect the amplifier as shown in Figure 5-3. R1 and R2 should be 1000 ohm, multiturn potentiometers to provide adequate resolution.

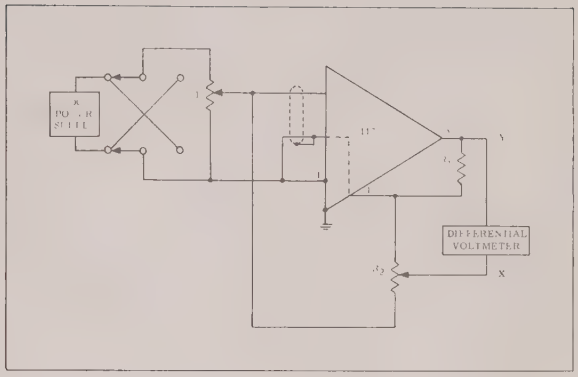


Figure 5-3 DC Gain Linearity Test Setup (Gain < 1)

m. Set the GAIN switch S1 to position .5.

n. Set R1 so that no voltage is applied to the amplifier.

o. Adjust the amplifier ZERO control until the voltage indicated by the differential voltmeter is zero ±3 millivolts.

p. Adjust the voltage dials on the differential voltmeter until the voltmeter indicates a null.

q. Adjust the power supply to +25 volts and rotate R1 until the voltage at the amplifier output is +2.5 volts.

r. Adjust R2 until the voltage between points X and Y, as indicated on the differential voltmeter, returns to the null point established in step p.

s. Adjust R1 until the voltage at the amplifier input is again zero volts. If the reading differs from that established in step p., repeat steps p., q., and r. until the voltmeter indicates a null at each step when applying zero or full scale input voltage.

t. Vary the input voltage from plus full scale to zero, then to minus full scale input voltage, and note the maximum change on the differential voltmeter.

u. Determine the linearity as in step j.

v. Repeat steps n. through u. with GAIN switch S1 set to positions .2 and .1. For GAIN settings .05, .02, and .01 it will be necessary to drive the amplifier directly from the DC power supply, and measure the input and output directly with the differential voltmeter. R1 and R2 should be removed at these lower gains, since the high input voltage required for the rated output would dissipate too much power in these resistors.

5-3-5 Common Mode Rejection

a. Connect the amplifier as shown in Figure 5-4.

Use an AC source that will provide up to 500 volts peak at the required common mode frequency. R1 is a 0-1000 ohm resistor. R_{CM} is a 0-100 kilohm resistor. T1 is described in paragraph 5-3-1d.

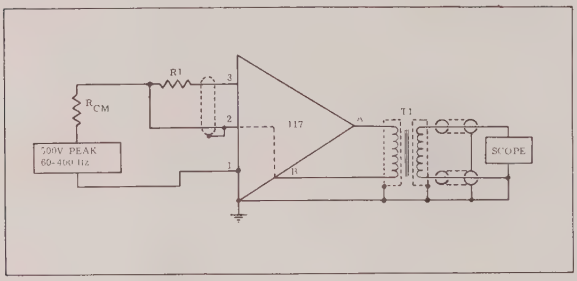


Figure 5-4 Common Mode Rejection Test Setup

b. Set GAIN switch S1 to position 10.

c. Set the oscillator output to a voltage within the common mode voltage (CMV) specifications (0-500 volts peak).

d. Measure the peak value of common mode voltage at the amplifier output $(E_o)_{cm}$.

e. Calculate the common mode rejection (in db) using the following equation:

$$CMR\ (db) = 20 \log \frac{E_{in} \times gain}{(E_o)_{cm}}$$

$$\text{Where: } \frac{E_{in}}{(E_o)_{cm}} = \frac{\text{CMV input (peak)}}{\text{CMV output (peak)}}$$

f. Repeat steps c., d., and e. for each position of GAIN switch S1.

g. To measure DC common mode rejection, connect the amplifier as shown in Figure 5-5. Use a low noise DC power supply and measure the common mode voltage at the output with a differential voltmeter.

(1) Connect the DC power supply and differential voltmeter to the amplifier.

(2) With DC power supply OFF, connect a jumper across the output of the power supply and measure the DC voltage output of the amplifier. If more than 10 millivolts is present, adjust the ZERO control.

(3) Remove jumper from power supply and adjust the power supply to the desired level of common mode voltage. Note the change in amplifier DC output voltage from the value noted in step (2).

(4) Calculate CMR using equation in step e. Note that the CMV output is only the change in amplifier output observed upon application of the DC common mode voltage.

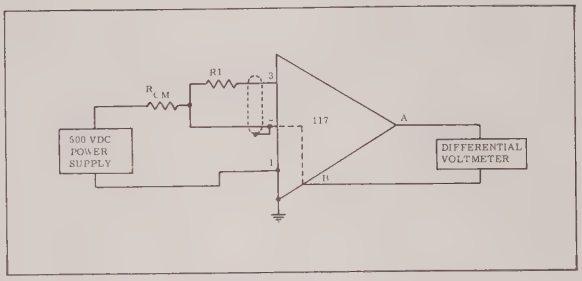


Figure 5-5 DC Common Mode Rejection Test Setup

5-3-6 Output Noise

a. Connect the amplifier as shown in Figure 5-6; isolate the true RMS voltmeter from ground at its power source to allow the test setup to float free. R1 is a wire-wound or metal film resistor of any value up to 10 kilohms (maximum source resistance).

b. At all positions of GAIN switch S1, measure the RMS output noise.

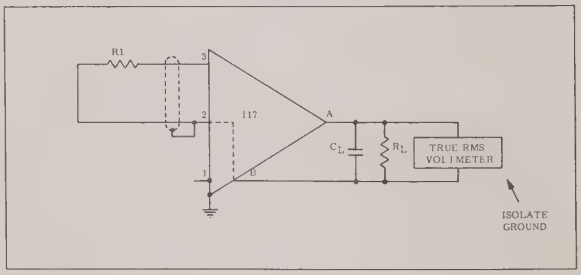


Figure 5-6 Noise Test Setup

5-4 CORRECTIVE MAINTENANCE

In the event of malfunction, normal troubleshooting techniques should be adopted. All plugs, leads, connectors, power supply voltages, and the fuse should be carefully checked.

5-4-1 Guidelines

a. As an aid to trouble analysis, key voltages have been listed on the detailed schematic. These voltages are for nominal AC line (115V or 230V), GAIN switch S1 set to INPUT SHORT, and GAIN

Table 5-1. Troubleshooting Guide (Cont'd)

SYMPTOM	PROBABLE CAUSE	SUGGESTED REMEDY
10. Servo OK but no response or faulty response from the input terminals.	Defect in the input attenuator, preamplifier, or preamplifier feedback attenuator.	Locate by checking dc levels and by tracing signals through input attenuator and preamplifier. Replace defective components.

D. CHECKOUT PROCEDURE

1. Paper Holddown Force and Vacuum System

Note

Perform step 1 with the pen assemblies removed.

Align a sheet of 11 x 16-1/2 inch paper on the plotting surface; set the PEN switch to UP. Check the force required to move the paper in a plane parallel to the plotting surface.

This force should be at least 7 ounces for 11 x 16-1/2 inch graph paper and 2.5 ounces for 8-1/2 x 11 inch graph paper.

2. Paper Load and Carriage Operation

Set the PEN switch to UP. Use the T-axis ZERO SHIFT control to establish a carriage zero position at the left margin of the recording area. Turn the PEN switch to LOAD. The carriage should move smoothly to the right margin of the recording area. Return the PEN switch to UP. The carriage should return to the established zero position.

Connect 0-16 ounce spring scale in center of Y-axis carriage bar and check the force required to move the carriage in the + and - direction. The force should not exceed 6 ounces and should not vary by more than ±1 ounce. If this requirement cannot be met, adjust the drive gear backlash, cable tension, or carriage bearings.

Connect spring scale to slider bracket assembly and measure the force necessary to move the slider bracket in the + and - directions. The force should not exceed 7 ounces and should not vary by more than ±1 ounce. If this requirement cannot be met, adjust the drive gear backlash, cable tension, or slider bracket free play.

Clutches are adjustable by means of the spacing of the aluminum spring retainer collar on the servo shaft assembly. Clutch should be adjusted so that it slips when the carriage or pen is physically displaced off-null, before the motor drive limiting circuit becomes active. With the clutch slipping, the force should be 12 oz. minimum in the X direction and 16 oz. minimum in the Y direction.

3. Pen Lift Operation

Use a clean sheet of 11 x 16-1/2 inch graph paper to check the pen-lift operation. Set the PEN switch to UP. Use the ZERO SHIFT controls to move the pen(s) around the edges and through the center of the graph paper. The pen tip(s) should clear the paper by 0.020 inches at all points.

Check the pen-down position by setting the PEN switch to DOWN. Move the pen(s) around the edges and through the center of the graph paper. Make certain that both pen(s) write everywhere on the paper. There should be an approximate 0.01 inch gap between the bottom of the pen arrow and the pen lifter.

Check the pen-lift for positive action. The pen-lift bar and the pen assemblies must snap up when the PEN switch is moved from DOWN to UP, and they must snap down when the switch is moved from UP to DOWN.

4. Pen Spring Tension

With the PEN switch set to DOWN, check the force holding the pen(s) on the graph paper. This force should be between 8 to 12 grams. (3 to 7 grams if mounted in the vertical position).

5. Paper Alignment

Ensure that the graph paper is properly aligned on the recording surface. Set the PEN switch to DOWN. Use the T-axis ZERO SHIFT control to draw straight horizontal lines with both pens. Use the Y and Y'-axes ZERO SHIFT controls to draw straight vertical lines.

6. Recording Area

Set the PEN switch to DOWN. Use the ZERO SHIFT controls to check that the pens write to the four margins of the graph paper.

Note

Ensure that pen or carriage travel is not limited by the mechanical stops in the followup potentiometer.

7. Dead Band

Turn the PEN switch to DOWN. Check the T-axis dead band by manually moving the

Symptom	Probable Cause	Suggested Remedy
4. Insufficient bandwidth.	a. Low loop gain.	a. Use ohmmeter to check connections and resistor values in feedback circuit, see paragraph 3-2-3.
	b. Accidental loading output with high capacitance or high impedance input source from bad connections.	b. Check test setup.
	c. Output level too high.	c. Check for 1.8 volts RMS as indicated in paragraph 5-3-3j.
5. Low output.	a. Defective power supply.	a. Check power supply, see paragraph 3-2-6.
	b. AC line voltage too low.	b. Check AC line with 2% meter. Check source select switch S4, see paragraph 2-4c.
	c. Defective current limiting.	c. Check power output stage, see paragraph 3-2-5.
	d. Incorrect load (R_L) in test setup.	d. Use output current and output voltage specifications in paragraph 1-5 to determine value of R_L.
6. Amplifier output zero on all gain settings.		
a. All channels.	a. No power.	a. Check power connector and fuse. Check source select switch S4, see paragraph 2-4c.
b. Individual channel.	b. Individual power supply.	b. Check supply, see paragraph 3-2-6.
7. Output excessive (high pos or neg) on all gain settings.	Open or shorted transistor.	Start at output and work toward input checking all transistors with ohmmeter.
8. Amplifier output oscillates at rate other than 60 Hz or 120 Hz.	a. Defective feedback element.	a. Check for opens, R22, R25, and C7, or C4, C5, and R19, see paragraphs 3-2-3 and 3-2-4.
	b. Feedback loop open.	b. Make visual check and continuity check, see paragraph 3-2-3.
9. Gain error on a single gain setting.	Contact of GAIN switch S1.	Clean switch contacts.
10. Output will not zero with R16.	a. R16 defective.	a. Replace.
	b. Q1 defective.	b. Replace, see paragraph 3-2-1.
11. Incorrect power supply output.	a. Defective regulator diodes.	a. Check voltage across CR111 and CR112, see paragraph 3-2-6.
	b. Defective transistors.	b. Check base-emitter voltages of Q110 and Q111, see paragraph 3-2-6.

Table 5-1 Troubleshooting Guide

SECTION VI — PARTS LIST

6-1 INTRODUCTION

The parts list is a breakdown of all assemblies and sub-assemblies which can be disassembled. Generally, parts are listed in order of disassembly sequence.

6-2 COLUMN EXPLANATIONS

a. References

This is a triple column which lists first the figure number of the illustration on which a particular index number will be found. The second column contains the index number of the item described. The third column lists the schematic reference designation or the item number of an electrical component.

b. Description

The item name appears in this column. Where applicable, the specification number, value, and/or reference which further identifies the item is also listed.

c. Manufacturer and Part Number

This is a double column which lists first the manufacturer's Federal Supply Code. This is a five digit code as described in the Federal Supply Code for Manufacturers (Cataloging Handbook H4-1 & H4-2). A letter code is assigned to manufacturers who do not have a Federal Supply Code Number. In some cases more than one manufacturer can supply an "or equal" part, but the intent is to show only one outside source. The second column lists the manufacturer's part number for all parts that may be ordered directly from the original manufacturer.

d. Honeywell Part Number

This column lists the number under which an item may be ordered directly from Honeywell Inc., Test Instruments Division, Denver. Certain items contain only Honeywell part numbers. These items are proprietary items that are available only from Honeywell.

e. Quantity per Assembly

This column lists a number which is the quantity of that item as used in a particular assembly.

f. Effectivity Code

The Effectivity Code column indicates the components which are peculiar to certain serial numbers. This is indicated by a code letter. Where the component is applicable to all serial numbers or options, the column is left blank.

The code letter(s) used in this column denotes a certain serial number(s) or options. If the Effectivity Code column is used, the breakdown of the code letters will be found in paragraph 6-9.

6-3 REFERENCE DESIGNATORS

The following lists the abbreviations used with schematic reference designators:

B	- motor	M	- meter
C	- capacitor	P	- plug
CR	- diode	Q	- transistor
DS	- device signaling (lamp)	R	- resistor
F	- fuse	RT	- thermistor
FL	- filter	S	- switch
J	- jack	T	- transformer
K	- relay	TP	- test point
L	- inductor	V	- vacuum tube

6-4 ABBREVIATIONS

The following abbreviations are used in the "Description" column of the parts list:

AC	- alternating current
AMP	- ampere
ARM	- armature
ASSY	- assembly
BAT	- battery
BLK	- black
BLO	- blower
BOT	- bottom
BRKT	- bracket
CAP	- capacitor
CRT	- cathode ray tube
CER	- ceramic
COMP	- composition
CONN	- connector
DIA	- diameter
DC	- direct current
VDC	- direct current volts
DIO	- diode
DP	- double pole
DPDT	- double pole double throw
DPST	- double pole single throw
DT	- double throw
ELECT	- electrolytic

FIG	- figure
FIL H	- fillister head
FXD	- fixed
4P	- four pole
GL	- glass
GRN	- green
GROM	- grommet
H	- henry
HEX	- hexagon
IN	- inches
K	- kilohm
L	- left
μF	- microfarad
$\mu\mu$F	- micromicrofarad
MTG	- mounting
MEG	- megohm
METFLM	- metal film
METMY	- metallic mylar
NHA	- next higher assembly
NO	- number
Ω	- ohm
ORN	- orange
POLY	- polystyrene
POT	- potentiometer
RES	- resistor
SP	- single pole
SPDT	- single pole double throw
SPEC	- specification
SPST	- single pole single throw
SOT	- value select on test
SEMICON	- semiconductor
Si	- Silicon
Ta	- tantalum
TGL	- toggle
V	- volt
W	- watts
WW	- wirewound

6-5 MANUFACTURER

Following is the list of manufacturers which appear in the parts list. The Federal Supply Code is listed in numerical order and corresponding manufacturer's name and address is given.

00779	AMP Inc. Eisenhower Boulevard Harrisburg, Pennsylvania
00872	Amelco Semiconductor Box 1030 Mountain View, California
01121	Allen Bradley Company 1201 South Second Street Milwaukee, Wisconsin
03979	Eldema Corporation 18435 Susana Road Compton, California
04062	El Menco Arco Electronics Inc. Community Drive Great Neck, New York
04713	Motorola Semiconductor Products Inc. Box 955 Phoenix, Arizona
04941	Walsco Electronic Manufacturing Co. Radio & Electronics Division Rockford, Illinois
06110	Helipot Div., Beckman Ins. 2500 Harbor Boulevard Fullerton, California 92634
06473	Amphenol Corporation 2801 South 25th Avenue Broadview, Illinois
07263	Fairchild Semiconductor Corporation 313 Fairchild Drive Mountain View, California
08065	Accurate Rubber & Plastics Company 4370 Jutland Drive San Diego, California
09213	General Electric Company Semiconductor Products Dept. of Electronic Components Buffalo, New York
13103	Thermalloy Company 8717 Diplomacy Row Dallas, Texas 75247
14936	General Instrument Corporation Semiconductor Products Group 600 West John Street Hicksville, New York
21604	Buckeye Stamping Company 555 Marion Road Columbus, Ohio
24655	General Radio 22 Baker Avenue West Concord, Massachusetts
28009	Honeywell Inc. Test Instruments Division 4800 East Dry Creek Road Denver, Colorado 80217
49671	Radio Corporation of America Electronics Components Devices 415 South Fifth Street Harrison, New Jersey

56289	Sprague Electric Company 125 Marshall Street North Adams, Massachusetts
70903	Belden Manufacturing Company 415 South Kilpatrick Avenue Chicago, Illinois 60644
71468	Cannon Electric Company 3208 Humboldt Street Los Angeles, California
71590	Centralab Division Globe Union Inc. Box 591 Milwaukee, Wisconsin
73445	Amperex Electronic Corporation 230 Duffy Avenue Hicksville, New York
75042	International Resistance Company 414 North 13th Street Philadelphia, Pennsylvania
75915	Littelfuse Inc. 800 East Northwest Highway Des Plaines, Illinois
80294	Bourns Inc. Trimpot Division 1200 Columbia Avenue Riverside, California
82389	Switchcraft Inc. 5537 Elston Avenue Chicago, Illinois
84171	Arco Electronics Inc. Community Drive Great Neck, New York
86684	RCA Semiconductor Division 415 South 5th Street Harrison, New Jersey 07029
87930	Tower Manufacturing Corporation 158 Pine Street Providence, Rhode Island
89665	United Transformer Company 150 Varick New York, New York
95146	Alco Products Inc. 3 Welcott Avenue Lawrence, Massachusetts
96971	Borg Equipment Division George W. Borg Corp. Janesville, Wisconsin
98978	International Electronic Research Corp. 135 West Magnolia Boulevard Burbank, California
A1000	Power Components Inc. P.O. Box 421 Scottdale, Pennsylvania
A2000	Farrel-Dwight Instrument Company 28 Argyle Place North Arlington, New Jersey

6-6 REFERENCE DESIGNATOR SHEET

The Reference Designator Sheet is used primarily to aid in locating an electrical component when the reference designator is known, therefore, the Reference Designator Sheet will be used for assemblies whose components are for the most part electrical.

a. Figure Column

The Figure Column lists the figure number to which the Reference Designator Sheet applies.

b. Reference Designator

The Reference Designator Column lists the schematic reference designators in alphanumeric order.

c. Item Number

The Item Number Column contains the item number which refers to the Parts List Sheet (See paragraph 6-2a). The item number may also have a footnote reference for additional information.

d. Page Number

The Page Number Column lists the page number where the corresponding component can be found.

e. Note

The Note Column contains additional information concerning the reference designators and effectivity code.

6-7 ORDERING INFORMATION

When ordering spare or replacement parts address your order or inquiry either to a Honeywell sales representative nearest you or to:

HONEYWELL INC.
TEST INSTRUMENTS DIVISION
P. O. BOX 5227
DENVER, COLORADO 80217

When ordering, always include the following information:

a. Model and serial number of instrument.

b. Honeywell part number.

c. Description.

d. If applicable, the reference designator.

e. If applicable, the next higher assembly.

6-8 PARTS LIST

The following lists all parts, less standard hardware. Parts that are subject to electrical or mechanical damage on an isolated or individual basis are listed. The listings provide ordering information for replacement parts and a means of component location through reference to an illustration.

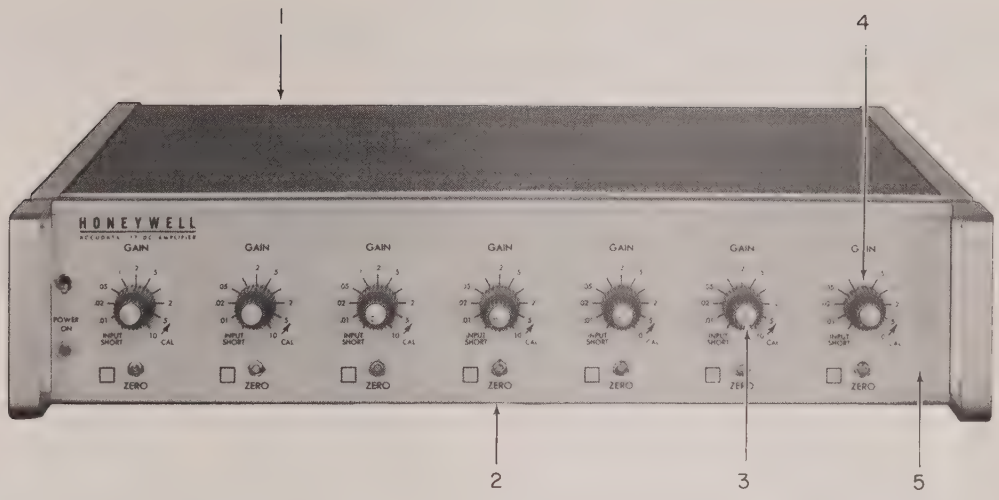
The parts list uses a system of column indentation to show the relationship between the various items.

6-9 EFFECTIVITY CODE

This parts list covers serial numbers 010001 to 0100090.

All options - no letter
117-04 - A
117-06 - B
117-07 - C
117-14 - D
117-16 - E
117-17 - F
117-07 - G (Used in serial nos. 0100001 thru 0100010 only)

See paragraph 1-4 for explanation of options.



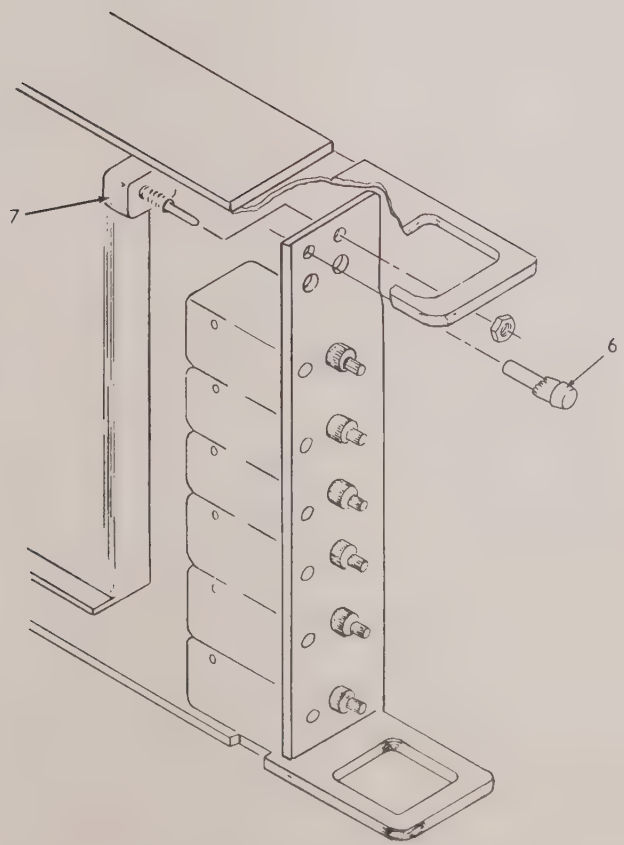


Figure 6-1 Front Panel Assy

REFERENCES FIG	IND	SCHEM OR ITEM	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	PART NO.	HONEYWELL PART NO.	QTY/ ASSY	EFF. CODE
			ACCUDATA 117 AMPLIFIER					
			. Power Cord	70903	KH 4147	16800209-001	1	
			. Plug Straight	71468	AN3106A-20-27S	16100171-001	1	
			. Collar, Plug	71468	AN3057-12	16750300-006	1	
			. Connector, Input	71468	XLR-3-11C	16761253-002	4	A, D
			. Connector, Input	71468	XLR-3-11C	16761253-002	6	B, E
			. Connector, Input	71468	XLR-3-11C	16761253-002	7	C, F
6-1			. FRONT PANEL ASSY					
	1		. . Cover, Top	28009		16766892-010	1	
	2		. . Cover, Bottom	28009		38521303-001	1	
			. . Rack Mtg. Ear	28009		16766902-002	2	
	3		. . Knob	21604	PS-50DL-1	16757252-402	4	A, D
	3		. . Knob	21604	PS-50DL-1	16757252-402	6	B, E
	3		. . Knob	21604	PS-50DL-1	16757252-402	7	C, F
	4		. . Knob	21604	PS-70CL-2	16757252-008	4	A, D
	4		. . Knob	21604	PS-70CL-2	16757252-008	6	B, E
	4		. . Knob	21604	PS-70CL-2	16757252-008	7	C, F
	5		. . Panel, Front, 7 Channel	28009		16775346-001	1	C, F, G
			. . Panel, Front, 6 Channel	28009		16775347-001	1	B, E
			. . Panel, Front, 4 Channel	28009		16775348-001	1	A, D
			. . . Plate, Designation, Channel Identification	28009		16775344-001	2	
			. . . Marker, Identification, Sensitivity	28009		16775345-002	4	A, D
			. . . Marker, Identification, Sensitivity	28009		16775345-002	6	B, E
			. . . Marker, Identification, Sensitivity	28009		16775345-002	7	C, F, G
	6	DS1	. . Indicator Light, neon	00779	2-380700-0	16738718-001	1	
	7	S3	. . Switch, Toggle	95146	MST-105D	16769156-001	1	
6-1								

REFERENCES			DESCRIPTION	MANUFACTURER'S		HONEYWELL	QTY/	EFF.
FIG	IND	SCHEM OR ITEM	1 2 3 4 5 6 7	CODE	PART NO.	PART NO.	ASSY	CODE
6-1			. FRONT PANEL ASSY (CONT.)					
			. . Number Button, five	28009		16305236-001	2	B,C,E,F
			. . Number Button, six	28009		16305237-001	2	B,C,E,F
			. . Number Button, seven	28009		16305238-001	2	C, E
6-1			. . Sub Panel	00116		38521300-001	1	
6-2			. REAR RAIL ASSY					
	1	J8	. . Connector	06473	AN3106A-20-27P	16100290-001	1	
	2	J9	. . Connector, power	87930	H-106-11G-3L	16750130-008	1	
	3		. . Fuseholder	75915	342012A	16800133-001	1	
		F1	. . Fuse, 3/4 amp Slo-Blo	75915	312.750	16800134-020	1	
	4	J10	. . Binding Post	24655	938A	13800132-001	1	
	5	S4	. . Switch, Slide	82389	42656LF	16765838-001	1	
	6	J1 thru J4	. . Connector	82389	B3M	13800281-001	4	A, D
	6	J1 thru J6	. . Connector	82389	B3M	13800281-001	6	B, E
	6	J1 thru J7	. . Connector	82389	B3M	13800281-001	7	C, F
	7	C11	. . Capacitor, fxd. cer. .01μf 1000V	71590	DD-1032	16731824-048	4	A, D
	7	C11	. . Capacitor, fxd. cer. .01μf 1000V	71590	DD-1032	16731824-048	6	B, E
	7	C11	. . Capacitor, fxd. cer. .01μf 1000V	71590	DD-1032	16731824-048	7	C, F
			. . Plug, Snap Hole	04941	7314	13800181-001	3	A, D
			. . Plug, Snap Hole	04941	7314	13800181-001	1	B, E
	8		. . Number Button (See Fig. 6-1 index No. 10)					
6-2	9		. . Rear Panel	00116		38521301-001		

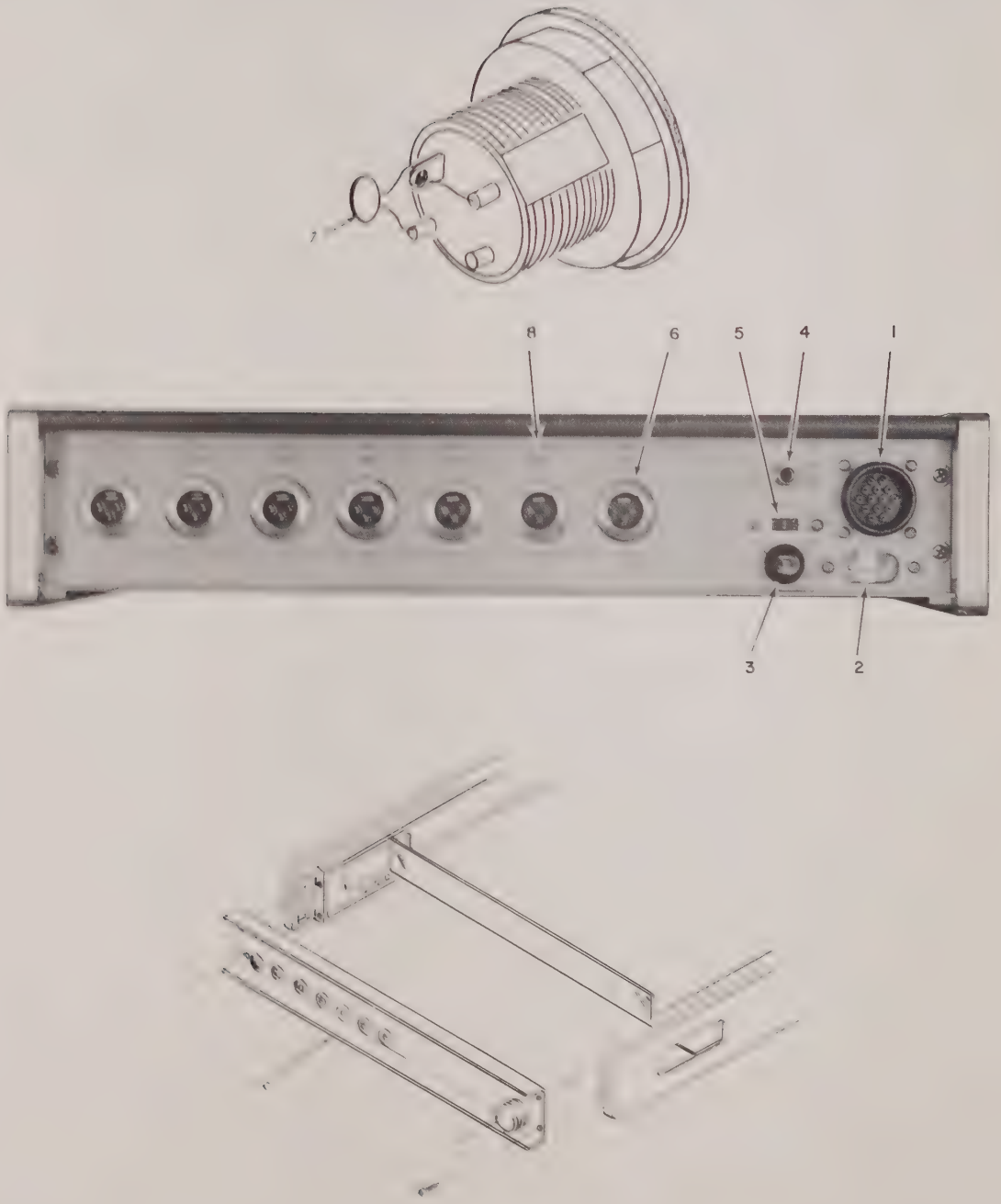


Figure 6-2 Rear Rail Assy

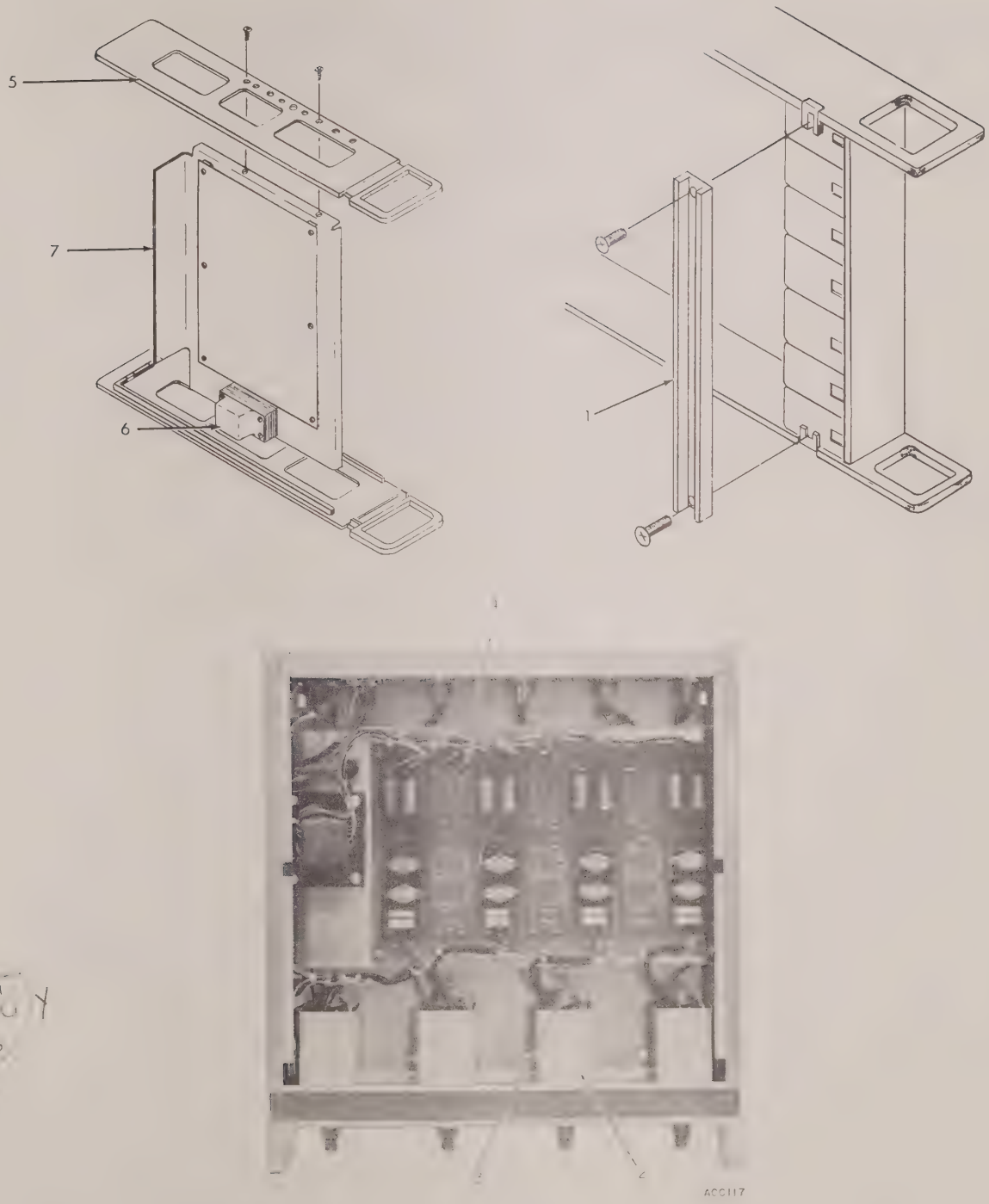
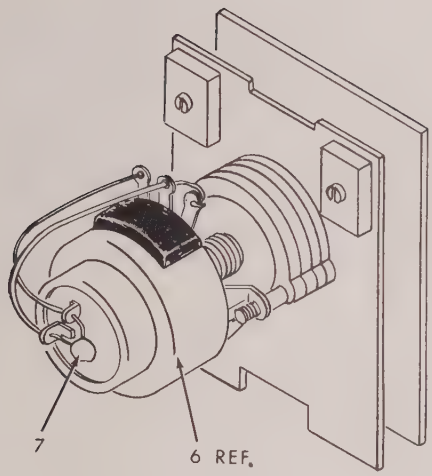


Figure 6-3 Chassis Assy

REFERENCES FIG	IND	SCHEM OR ITEM	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NO.	HONEYWELL PART NO.	QTY/ ASSY	EFF. CODE
6-3			. CHASSIS ASSY					
	1		. . Mounting Trim	28009		16766886-001	2	
	2		. . Cover, Shield	00116		38521012-001	4	A, D
	2		. . Cover, Shield	00116		38521012-001	6	B, E
	2		. . Cover, Shield	00116		38521012-001	7	C, F
	3		. . Switch Assy (See Fig. 6-4 for breakdown)					
	4		. . Power Supply Assy (See Fig. 6-7 for breakdown)					
	5		. . Side Panel	28009		16766894-013	2	
	6	T1	. . Transformer, Power	89665	R-42	16800052-001	1	
	7		. . Mounting Shelf	00116		38521306-001	1	
			. . Grommet	A2000	212-180402-47	16738490-001	6	
6-3			. . Grommet	08065	GB225	16800379-001	1	



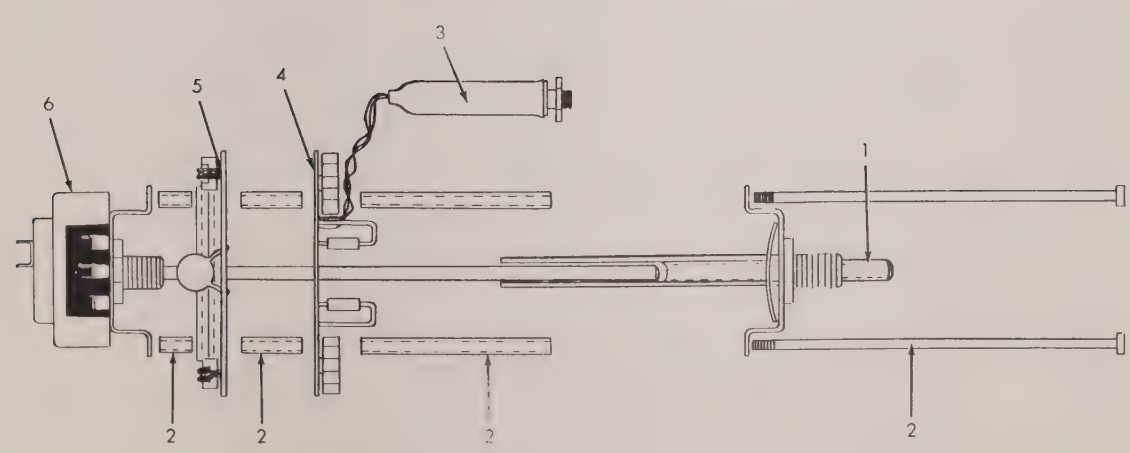
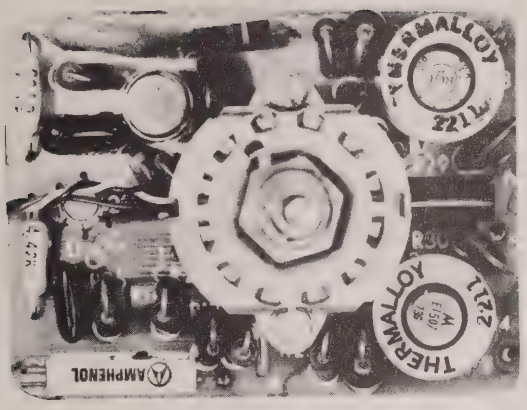
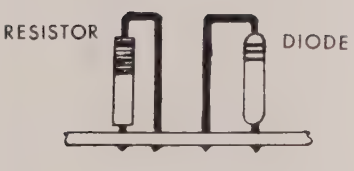
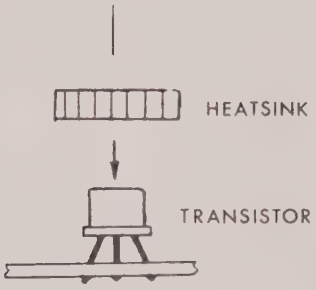


Figure 6-4 Switch Assy

REFERENCES			DESCRIPTION	MANUFACTURER'S		HONEYWELL	QTY/	EFF.
FIG	IND	SCHEM OR ITEM	1 2 3 4 5 6 7	CODE	PART NO.	PART NO.	ASSY	CODE
6-4			. SWITCH ASSY (See Fig. 6-3 for NHA)	28009		38521006-001	4	A, D
			. SWITCH ASSY (See Fig. 6-3 for NHA)	28009		38521006-001	6	B, E
			. SWITCH ASSY (See Fig. 6-3 for NHA)	28009		38521006-001	7	C, F
	1	S1, S2	. . Switch, Rotary	28009		16800047-002	1	
	2		. . . Hardware supplied with switch					
	3	R16	. . Potentiometer, 2K (ZERO)	80294	271-1-202M	16750052-448	1	A,B,C, D,E,F
	3	R16	. . Potentiometer, 5K (ZERO)	80294	271-1-502M	16750052-348	1	G
	4		. . Amplifier Board Assy (See Fig. 6-5 for component breakdown)	28009		38521008-001		
	5		. . Attenuator Board Assy (See Fig. 6-6 for component breakdown)	28009		38521014-001		
	6	R23	. . Potentiometer, 10K (VERNIER GAIN)	28009		16800026-001	1	
6-4	7	C8	. . Capacitor, fxd. cer. 150$\mu\mu$f 1000V	71590	DD-151	16750036-001	1	







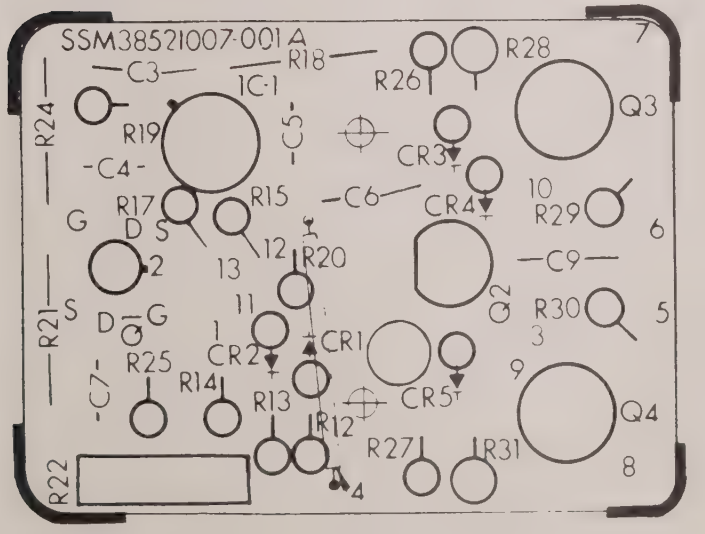
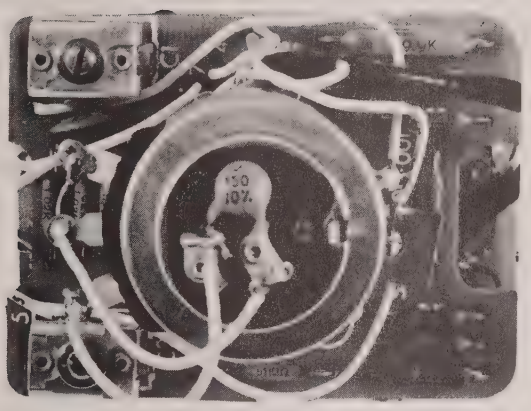


Figure 6-5 Amplifier Assy

FIG	REF DESIG	ITEM NO	PAGE NO	NOTE	FIG	REF DESIG	ITEM NO	PAGE NO	NOTE	FIG	REF DESIG	ITEM NO	PAGE NO
6-5	C3	1	6-15	a: See Fig. 6-5	6-5	R26	21	6-16					
	C4	5				R27	23						
	C5	4				R28	24	6-16					
	C6	1				R29	16	6-15					
	C7	3				R30	16	6-15					
	C9	2			6-5	R31	24	6-16					
	CR1	6											
	CR2	6											
	CR3	7											
	CR4	7											
	CR5	7											
	IC-1	8											
	Q1	10											
	Q2	9											
	Q3	12											
	Q4	11	6-15										
	R12	19	6-16										
	R13	18	6-15										
	R14	19	6-16										
	R15	15	6-15										
	R16	a											
	R17	15											
	R18	17	6-15										
	R19	22	6-16										
	R20	17	6-15										
	R21	14	6-15										
	R22	25	6-16										
	R23	a											
	R24	13	6-15										
6-5	R25	20	6-16										

REFERENCES			DESCRIPTION	MANUFACTURER'S		HONEYWELL	QTY/	EFF.
FIG	IND	SCHEM OR ITEM	1 2 3 4 5 6 7	CODE	PART NO.	PART NO.	ASSY	CODE
6-5			. AMPLIFIER BOARD ASSY (See Fig. 6-4 for NHA)	28009		38521008-001	REF	
		1	. . Capacitor, fxd. cer. .1μf 50V	56289	53C4185	16757455-008	2	
		2	. . Capacitor, fxd. mylar .01μf 100V	09213	75F1R5C-103	16763563-218	1	
		3	. . Capacitor, fxd. durmica 100μμf 500V	04062	DM-15-101J	16761549-027	1	
		4	. . Capacitor, fxd. durmica 20μμf 500V	04062	DM-15-200J	16761549-010	1	
		5	. . Capacitor, fxd. durmica 510μμf 500V	04062	DM-15-511J	16761549-044	1	
		6	. . Semiconductor Device, Diode	28009	E1580	16800061-001	2	
		7	. . Semiconductor Device, Diode	28009	1N914	16756865-001	3	
		8	. . Integrated Circuit, linear amplifier	07263	UA 709	16763333-001	8	
		9	. . Transistor, Si, PNP	04713	2N3906	16762173-001	1	
		10	. . Transistor	00872	SU2080	16766552-007	1	
		11	. . Transistor Spec. No. 001-507-01	28009		16800060-001	1	
		12	. . Transistor, Si, NPN	49671	2N3053(40053)	16763169-001	1	
			. . Heatsink	07387	3AL680-2R	16750167-003	2	
		13	. . Resistor, fxd. metal film 604Ω 1/8W 1%	75042	CEA T2 604Ω 1%	16757165-176	1	
		14	. . Resistor, fxd. metal film 4.42K 1/8W 1%	75042	CEA T2 4.42K 1%	16757165-263	1	
		15	. . Resistor, fxd. metal film 19.6K 1/8W 1%	75042	CEA T2 19.6K 1%	16757165-329	2	
		15	. . Resistor, fxd. metal film 18.2K 1/8W 1%	75042	CEA T2 18.2K 1%	16757165-326	2	G
		16	. . Resistor, fxd. comp. 20Ω ½W 5%	01121	EB2005	16750076-508	2	
		17	. . Resistor, fxd. comp. 100Ω ½W 5%	01121	EB1015	16750076-525	2	
6-5		18	. . Resistor, fxd. comp. 200Ω ½W 5%	01121	EB2015	16750076-532	1	

REFERENCES			DESCRIPTION	MANUFACTURER'S		HONEYWELL	QTY/	EFF.
FIG	IND	SCHEM OR ITEM	1 2 3 4 5 6 7	CODE	PART NO.	PART NO.	ASSY	CODE
6-5			. AMPLIFIER BOARD ASSY (CONT)					
		19	. . Resistor, fxd. comp. 680Ω ½W 5%	01121	EB6815	16750076-545	2	
		20	. . Resistor, fxd. comp. 1K ½W 5%	01121	EB1025	16750076-549	1	
		21	. . Resistor, fxd. comp. 1.2K ½W 5%	01121	EB1225	16750076-551	1	
		22	. . Resistor, fxd. comp. 1.5K ½W 5%	01121	EB1525	16750076-554	1	
		23	. . Resistor, fxd. comp. 2.7K ½W 5%	01121	EB2725	16750076-560	1	
		24	. . Resistor, fxd. WW 130Ω 2W 5%	75042	BWH 130Ω 5%	16756611-052	2	
6-5		25	. . Resistor, Variable 2K	06110	79PR2K	16765947-008	1	



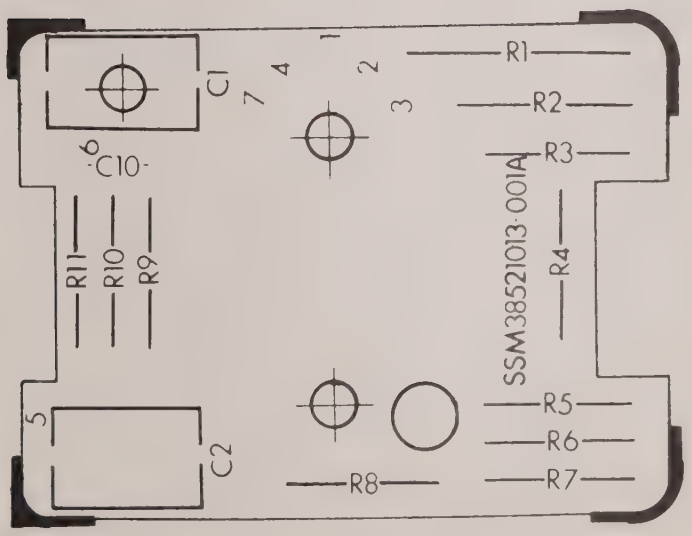
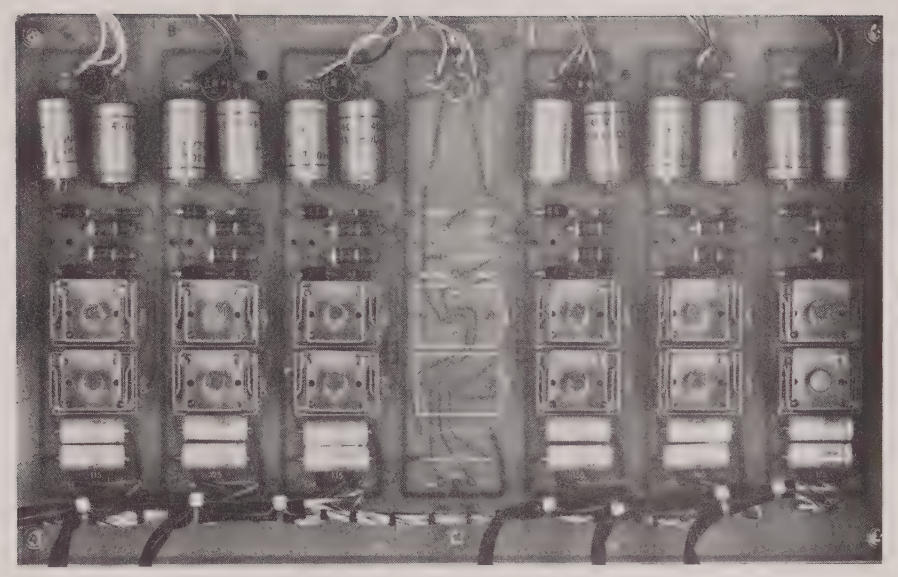


Figure 6-6 Attenuator Board Assy

ATTENUATOR BOARD ASSY

FIG	REF DESIG	ITEM NO	PAGE NO	NOTE	FIG	REF DESIG	ITEM NO	PAGE NO	NOTE	FIG	REF DESIG	ITEM NO	PAGE NO
6-6	C1	2	6-19										
	C2	2											
	C10	1											
	R1	12											
	R2	3											
	R3	11											
	R4	10											
	R5	9											
	R6	8											
	R7	7											
	R8	6											
	R9	5											
	R10	4											
6-6	R11	4	6-19										

REFERENCES FIG	IND	SCHEM OR ITEM	DESCRIPTION 1 2 3 4 5 6 7	MANUFACTURER'S CODE	MANUFACTURER'S PART NO.	HONEYWELL PART NO.	QTY/ ASSY	EFF. CODE
6-6			. ATTENUATOR BOARD ASSY (See Fig. 6-4 for NHA)	28009		38521014-001	REF	
		1	. . Capacitor, fxd. cer. .0018μf 1000V	71590	DD-182	13750033-025	1	
		2	. . Capacitor, Variable, 3-35pf, 175V	84171	CM-15-C-100-J	16750001-005	2	
		3	. . Resistor, fxd. metal film 511K ½W 1%	75042	CEB T2 511K 1%	16757161-469	1	
		4	. . Resistor, fxd. metal film 1.02K 1/8W 1%	75042	CEA T2 1.02K 1%	16757165-202	2	
		5	. . Resistor, fxd. metal film 3.09K 1/8W 1%	75042	CEA T2 3.09K 1%	16757165-248	1	
		6	. . Resistor, fxd. metal film 5.11K 1/8W 1%	75042	CEA T2 5.11K 1%	16757165-269	1	
		7	. . Resistor, fxd. metal film 10.2K 1/8W 1%	75042	CEA T2 10.2K 1%	16757165-302	1	
		8	. . Resistor, fxd. metal film 30.9K 1/8W 1%	75042	CEA T2 30.9K 1%	16757165-348	1	
		9	. . Resistor, fxd. metal film 51.1K 1/8W 1%	75042	CEA T2 51.1K 1%	16757165-369	1	
		10	. . Resistor, fxd. metal film 102K 1/8W 1%	75042	CEA T2 102K 1%	16757165-402	1	
		11	. . Resistor, fxd. metal film 309K 1/8W 1%	75042	CEA T2 309K 1%	16757165-448	1	
		12	. . Resistor, fxd. metal film 49.9K ½W 1%	75042	MEB T0 49.9K 1%	16757166-368	1	



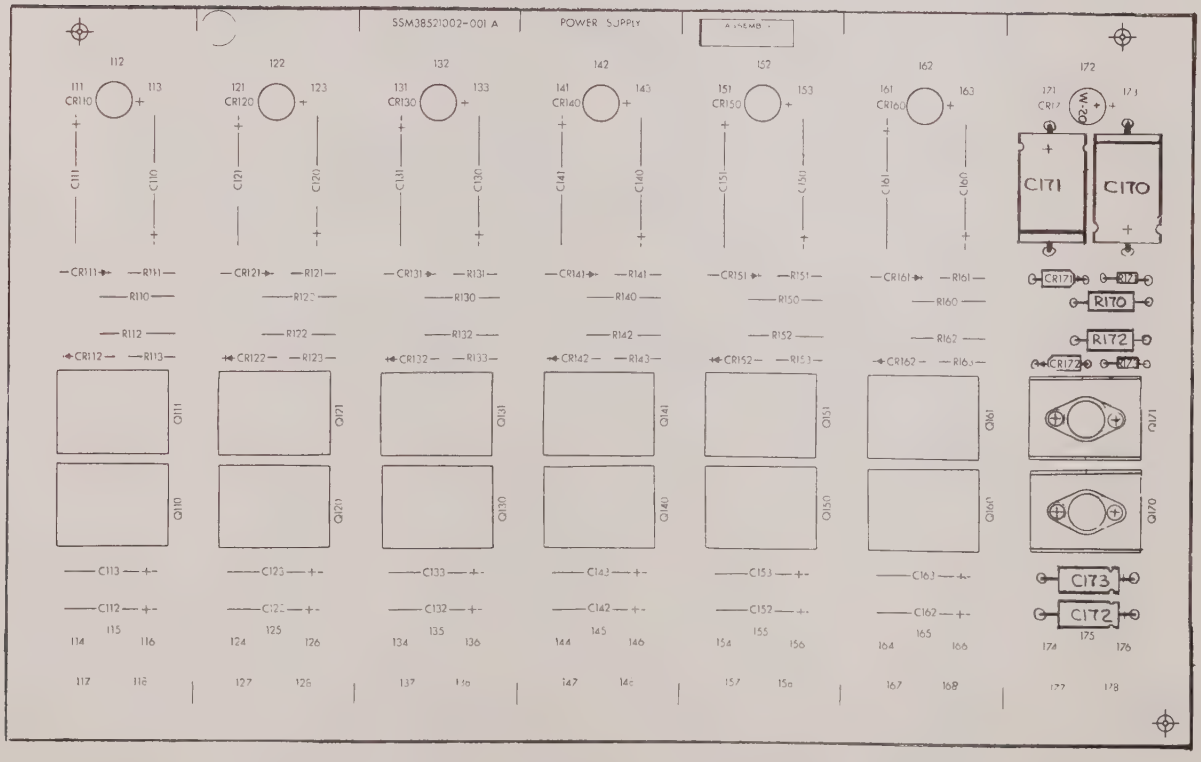


Figure 6-7 Power Supply Assy

FIG	REF DESIG	ITEM NO	PAGE NO	NOTE
6-7	C110	1	6-23	*: applies to effectivity code letters B, C, E, F
	C111	1		
	C112	2		
	C113	2		#: applies to effectivity code letters C, F
	C120*	1		
	C121*	1		
	C122*	2		
	C123*	2		
	C130	1		
	C131	1		
	C132	2		
	C133	2		
	C140#	1		
	C141#	1		
	C142#	2		
	C143#	2		
	C150	1		
	C151	1		
	C152	2		
	C153	2		
	C160*	1		
	C161*	1		
	C162*	2		
	C163*	2		
	C170	1		
6-7	C171	1	6-23	

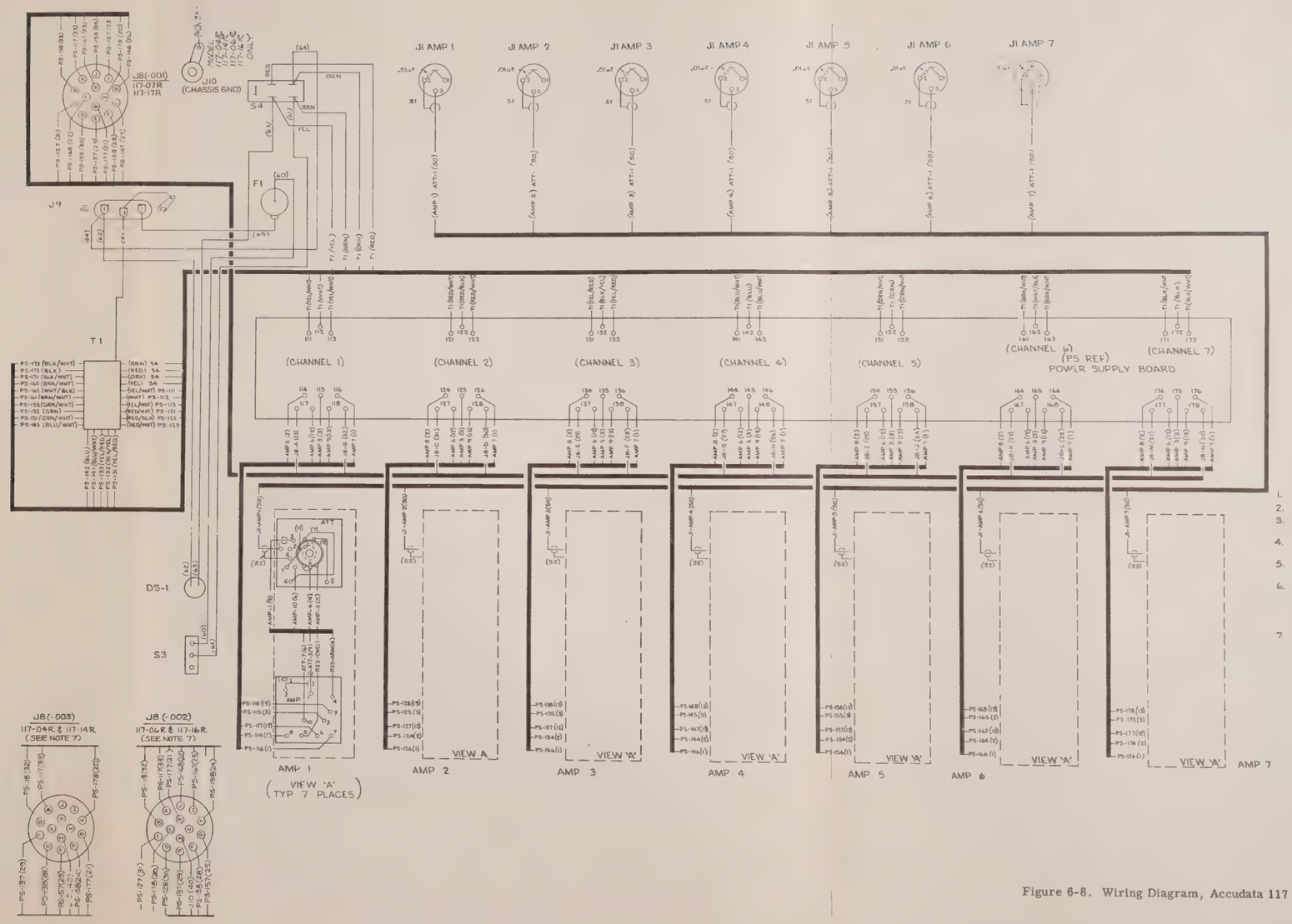
FIG	REF DESIG	ITEM NO	PAGE NO	NOTE
6-7	C172	2	6-23	
	C173	2		
	CR110	3		
	CR111	4		
	CR112	4		
	CR120*	3		
	CR121*	4		
	CR122*	4		
	CR130	3		
	CR131	4		
	CR132	4		
	CR140#	3		
	CR141#	4		
	CR142#	4		
	CR150	3		
	CR151	4		
	CR152	4		
	CR160*	3		
	CR161*	4		
	CR162*	4		
	CR170	3		
	CR171	4		
6-7	CR172	4	6-23	

FIG	REF DESIG	ITEM NO	PAGE NO
6-7	Q110	5	6-23
	Q111	6	
	Q210*	5	
	Q211*	6	
	Q310	5	
	Q311	6	
	Q410#	5	
	Q411#	6	
	Q510	5	
	Q511	6	
	Q610*	5	
	Q611*	6	
	Q710	5	
	Q711	6	6-23
	R110	8	6-24
	R111	7	
	R112	8	
	R113	7	
	R210*	8	
	R211*	7	
	R212*	8	
6-7	R213*	7	6-24

FIG	REF DESIG	ITEM NO	PAGE NO	NOTE	FIG	REF DESIG	ITEM NO	PAGE NO	NOTE	FIG	REF DESIG	ITEM NO	PAGE NO
6-7	R310	8	6-24	*: applies to effectivity code letters B, C, E, F									
	R311	7											
	R312	8											
	R314	7		#: applies to effectivity code letters C, F									
	R410#	8											
	R411#	7											
	R412#	8											
	R413#	7											
	R510	8											
	R511	7											
	R512	8											
	R513	7											
	R610*	8											
	R611*	7											
	R612*	8											
	R613*	7											
	R710	8											
	R711	7											
	R712	8											
6-7	R713	7	6-24										

REFERENCES			DESCRIPTION	MANUFACTURER'S		HONEYWELL	QTY/	EFF.
FIG	IND	SCHEM OR ITEM	1 2 3 4 5 6 7	CODE	PART NO.	PART NO.	ASSY	CODE
6-7			. POWER SUPPLY BOARD ASSY (See Fig. 6-3 for NHA)	00116		38521003-001	1	C, F
			. POWER SUPPLY BOARD ASSY (See Fig. 6-3 for NHA)	00116		38521003-002	1	B, E
			. POWER SUPPLY BOARD ASSY (See Fig. 6-3 for NHA)	00116		38521003-003	1	A, D
		1	. . Capacitor, fxd. elect. 400μf 40V	73445	C437 AR G400	16758518-315	14	C, F
		1	. . Capacitor, fxd. elect. 400μf 40V	73445	C437 AR G400	16758518-315	12	B, E
		1	. . Capacitor, fxd. elect. 400μf 40V	73445	C437 AR G400	16758518-315	8	A, D
		2	. . Capacitor, fxd. elect. 50μf 25V	56289	30D200A1	16756939-413	14	C, F
		2	. . Capacitor, fxd. elect. 50μf 25V	56289	30D200A1	16756939-413	12	B, E
		2	. . Capacitor, fxd. elect. 50μf 25V	56289	30D200A1	16756939-413	8	A, D
		3	. . Semiconductor, Device, Diode Bridge	14936	W02	16759755-002	7	C, F
		3	. . Semiconductor, Device, Diode Bridge	14936	W02	16759755-002	6	B, E
		3	. . Semiconductor, Device, Diode Bridge	14936	W02	16759755-002	4	A, D
		4	. . Semiconductor, Device, Diode	A1000	TZ-16C	16759870-011	14	C, F
		4	. . Semiconductor, Device, Diode	A1000	TZ-16C	16759870-011	12	B, E
		4	. . Semiconductor, Device, Diode	A1000	TZ-16C	16759870-011	8	A, D
		5	. . Transistor, Si. NPN	86684	2N3054	16763169-002	7	C, F
		5	. . Transistor, Si. NPN	86684	2N3054	16763169-002	6	B, E
		5	. . Transistor, Si. NPN	86684	2N3054	16763169-002	4	A, D
		6	. . Transistor, Si. PNP	04713	2N3740	16763116-001	7	C, F
		6	. . Transistor, Si. PNP	04713	2N3740	16763116-001	6	B, E
		6	. . Transistor, Si. PNP	04713	2N3740	16763116-001	4	A, D
			. . Heatsink	13103	6166B	16771278-002	14	C, F
			. . Heatsink	13103	6166B	16771278-002	12	B, E
6-7			. . Heatsink	13103	6166B	16771278-002	8	A, D

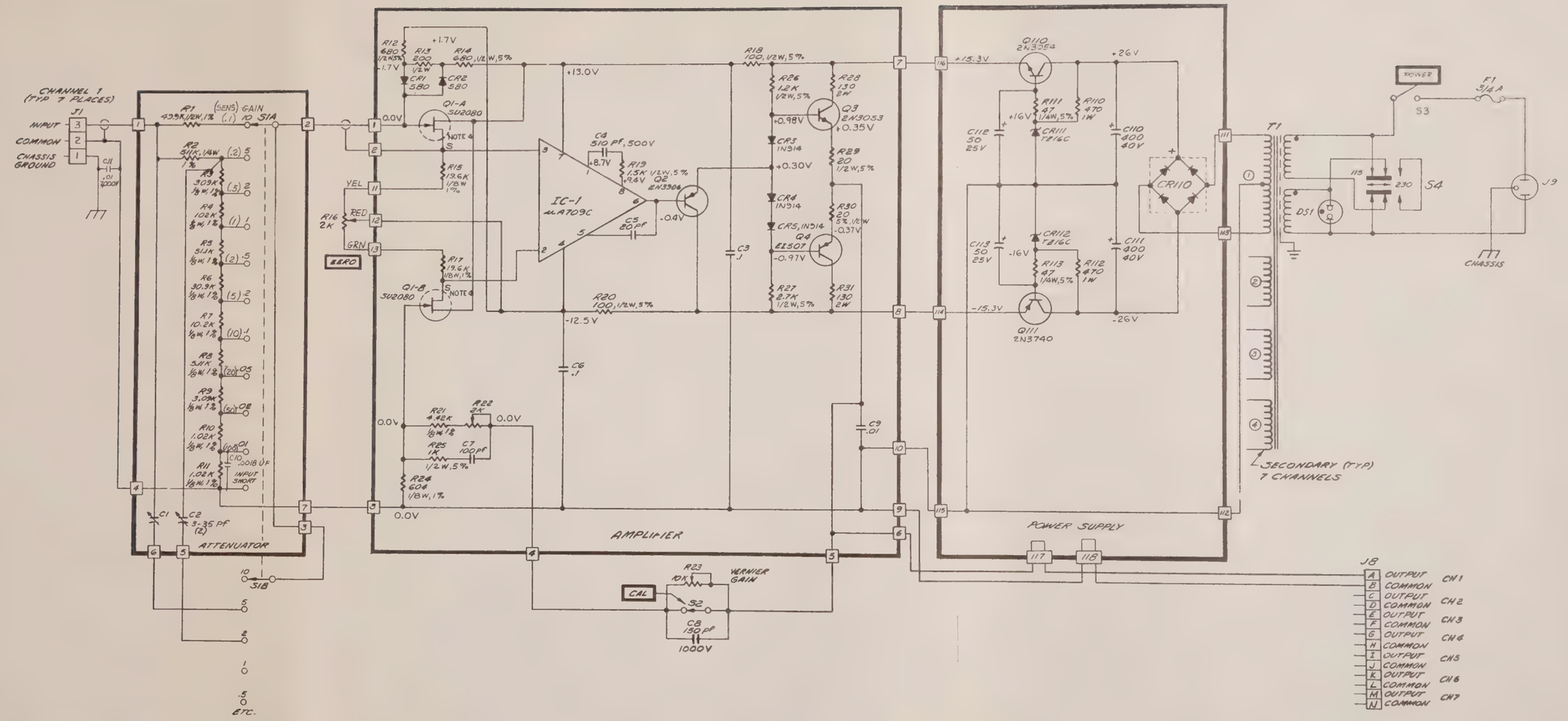
REFERENCES			DESCRIPTION	MANUFACTURER'S		HONEYWELL	QTY/	EFF.
FIG	IND	SCHEM OR ITEM	1 2 3 4 5 6 7	CODE	PART NO.	PART NO.	ASSY	CODE
6-7			. POWER SUPPLY BOARD ASSY (CONT)					
		7	. . Resistor, fxd. comp. 47Ω $\frac{1}{4}$W 5%	01121	CB4705	16750079-001	14	C, F
		7	. . Resistor, fxd. comp. 47Ω $\frac{1}{4}$W 5%	01121	CB4705	16750079-001	12	B, E
		7	. . Resistor, fxd. comp. 47Ω $\frac{1}{4}$W 5%	01121	CB4705	16750079-001	8	A, D
		8	. . Resistor, fxd. comp. 470Ω 1W 5%	01121	GB4715	16750077-555	14	C, F
		8	. . Resistor, fxd. comp. 470Ω 1W 5%	01121	GB4715	16750077-555	12	B, E
6-7		8	. . Resistor, fxd. comp. 470Ω 1W 5%	01121	GB4715	16750077-555	8	A, D



NOTES.
UNLESS OTHERWISE SPECIFIED

1. ALL WIRE 22 GAUGE
2. ⊖ RG-174/U (16750961004)
3. NUMBERS IN (---) REFER TO HARNESS WIRE NUMBERS
4. MODELS 117-06 & 117-16 OMIT CHANNEL 4
5. MODELS 117-04 & 117-14 OMIT CHANNELS 2,4,6
6. WIRE NO'S ASSY
   1 - 19 IN 38521011
   20 - 49 IN 38521009
   50 - 59 IN 38521010
   60 - 69 IN 38521005
7. J8(-002 & -003) SUBSTITUTED FOR J8(-001) AS APPLICABLE FOR MODEL DESIRED.

Figure 6-8. Wiring Diagram, Accudata 117 Multichannel DC Amplifier
Doc. No. 38521019A



NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL CAPACITORS TO BE IN MICROFARADS
2. VOLTAGES AT THESE POINTS CAN VARY 0 TO ±1.5 V AROUND A NOMINAL OF +2.0 VOLTS
3. ALL VOLTAGES ARE FOR NOMINAL LINE (117 OR 230 V) AMPLIFIER INPUT SHORTED, ANY GAIN SETTING, AND ARE RELATIVE TO COMMON

Figure 6-9. Schematic Diagram, Accudata 117 Multichannel DC Amplifier
Doc. No. 38521017G

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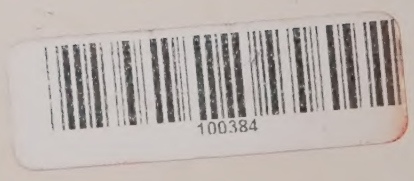
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